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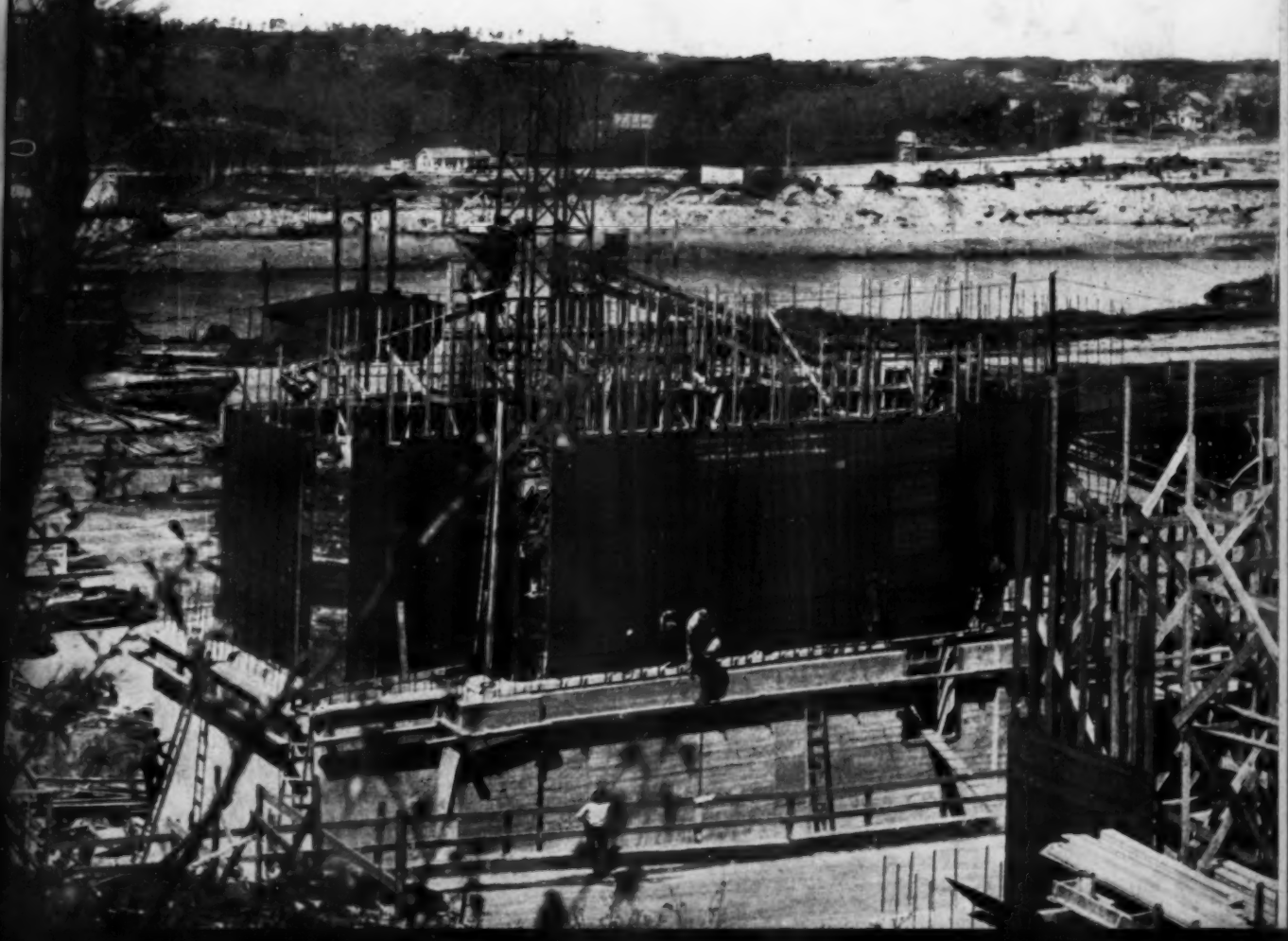
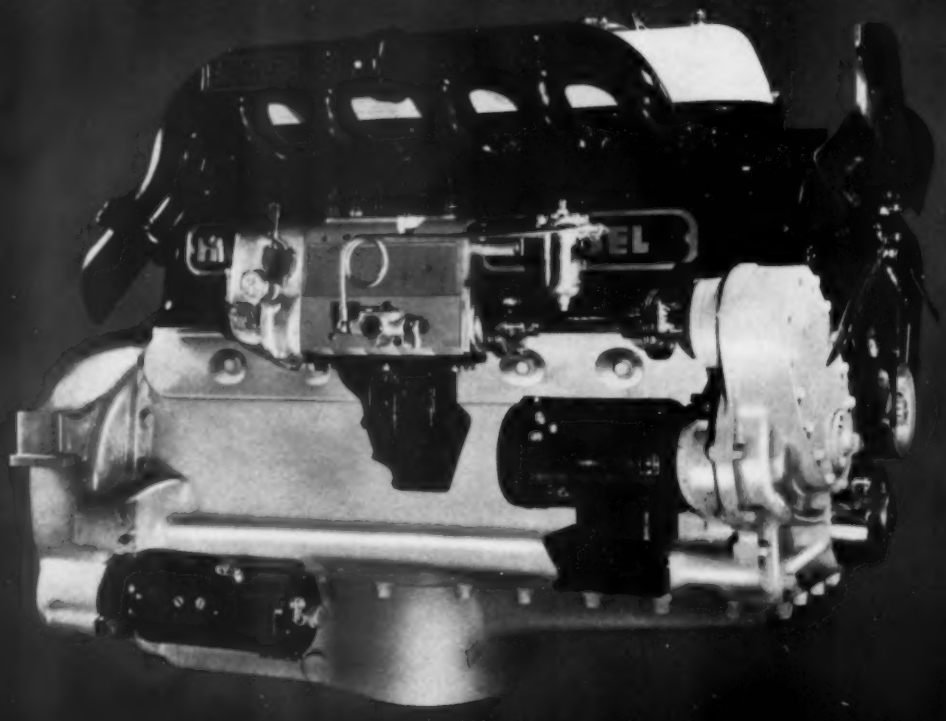


The South Abutment Pier of One of the New Cape Cod Canal Highway Bridges Now Under Construction in Massachusetts

See page 21

HERCULES DIESEL ENGINES



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MANUFACTURERS OF HEAVY-DUTY INTERNAL COMBUSTION ENGINES AND POWER UNITS—FROM 6 TO 200 HORSEPOWER

Features *of* Concreting *on the* New Cape Cod Canal Highway Bridges

The New Bridges Will Eliminate Constant Interruptions of Highway Traffic

P. J. Carlin Construction Co. Must Pour 5,000 Cubic Yard Monoliths Without Interruption

A CHALLENGE to the ingenuity of any single contractor, the contract for the substructures of the new Bourne and Sagamore highway bridges over the Cape Cod Canal calls for the pouring of the footings of the four main channel piers at the rate of 200 cubic yards per hour and without interruption. To meet this requirement, which is comparable to the rate of concrete production at Boulder Dam, the P. J. Carlin Construction Co., of New York City, has developed concreting methods which warrant study and undoubtedly set an all-high for ingenuity and flexibility.

General Description of the Cape Cod Bridge Projects

Marine traffic through the Cape Cod Canal, which was opened in 1914, has increased tremendously since the United States Government purchased this water way in March, 1928, from the private corporation which built it. The existing bridges, two double-leaf bascule span highway bridges and one single bascule span railroad bridge, were opened so frequently that highway traffic, which during the summer months is unusually heavy, was constantly delayed. Only the smallest cabin cruisers could make the transit of the Canal without the necessity of raising all three bridges. The two new highway bridges, designated as the Sagamore Bridge and the Bourne Bridge and approximately 3 miles apart, will have a clearance of more than 135 feet from mean high water while the lift span bridge at Buzzards Bay for the tracks of the New York, New Haven & Hartford Railroad will have a lift clearance of like amount. The new Sagamore Bridge is 2,500 feet west of the present low level bridge at the junction of Massachusetts Route 3 and U. S. Route 6, and the new Bourne Bridge is 3,235 feet east of the existing structure carrying Massachusetts Route 28 which serves the southern part of Cape Cod. The new single track railroad bridge is only 60 feet east of the present double-track structure and will remain open except when the few daily trains approach.

The Bourne Bridge is 2,684 feet in length overall and carries a 40-foot roadway and one 6-foot 8-inch sidewalk. The Sagamore Bridge is 1,833 feet from abutment to abutment with roadway and sidewalk of the same dimensions as the Bourne Bridge. The railroad bridge, not included in the contract described in this article, has a 544-foot lift span with two 128-foot immovable approach spans. This lift bridge is the longest of its type in the world.

The concrete quantities for the Bourne Bridge are as follows:

North abutment	5,190 cubic yards
South abutment	5,835 cubic yards
Main pier South	8,871 cubic yards
Main pier North	8,781 cubic yards
Intermediate pier No. 3	2,590 cubic yards
Intermediate pier No. 4	2,590 cubic yards
Intermediate pier No. 5	1,972 cubic yards
Intermediate pier No. 6	2,573 cubic yards

The quantities for the Sagamore Bridge are:

North abutment	8,475 cubic yards
South abutment	8,463 cubic yards
Main pier South	8,965 cubic yards
Main pier North	8,955 cubic yards

The total concreting on this job involved the use of 70,000 barrels of Lehigh cement and 30,000 barrels of Universal Atlas cement.

Bids for the highway bridges were advertised on November 4, 1933, and opened on November 20. The contract was awarded November 27 to P. J. Carlin Construction Co., of New York City. The contract for the railroad bridge was awarded to Blakeslee-Rollins Corp., of New Haven, Conn., on December 5, 1934, by the Federal Government through the Corps of Engineers, U. S. A., which also awarded the highway bridge contract to P. J. Carlin Construction Co. By a very satisfactory and economical arrangement, the P. J. Carlin Construction Co. subcontracted the construction of the four main channel pier cofferdams to the Blakeslee-Rollins Corp., which specializes in this type of work. The latter corporation, which must use between 25,000 and 30,000 cubic yards of concrete in its piers, is buying the concrete from P. J. Carlin.

Distribution of Concreting Facilities

At the site of the North Bourne piers and abutment, the contractor set up a complete plant for handling aggregate, for batching and for mixing concrete which will be described in detail later. At this point also, the shops, main storage sheds and garages for truck service were located. A double track spur from Buzzards Bay was laid for about a mile from a lumber yard located at the old Bourne Bridge. At South Bourne, the contractor set up a batching plant practically identical with that at North Bourne but erected no mixing plant. At South Sagamore, another duplicate of the North Bourne plant was erected except that one of the aggregate bins was a converted 200-ton cement bin which was used by P. J. Carlin on his Rikers Island, New York, prison contract. At North Sagamore, there was no batching or concreting plant, all concrete being hauled from South Sagamore by agitator trucks or dry-batched at South Sagamore and mixed in pavers at North Sagamore.

The Sand Washing Plant

Located on the south side of the canal, about midway between the Bourne and Sagamore bridges, the contractor set up a complete sand washing plant. The Cape Cod area abounds in glacial drift, much of it with a minimum of gravel and these pits produce excellent concrete sand. A Sauerman Crescent drag scraper and Sauerman hoist pulled in the sand and gravel for a distance of about 115 feet to a rail grizzly with 4½-inch openings. Oversize raked off the grizzly was delivered to a No. 4½ Climax jaw crusher powered with a Climax 75-horsepower gas engine. A bucket elevator beneath the grizzly carried the sand and smaller stone to the Telsmith circular screens at the top

The Sand Washing Plant on the South Side of the Canal, Mid-Way Between the Two Bridges

of the plant. These circular screens are 32 inches in diameter and are equipped with internal spray to wash the stone and outside spray to prevent clogging. Oversize material went to a hopper at the lower end of the plant from which it was hauled by a truck to the crusher. Crushed material was delivered to the hopper beneath the grizzly. The screened stone goes through a final scrubber and the sand to a pair of screw rewashers. From the hoppers beneath the Telsmith plant, the sand is hauled by trucks to the various batching plants.

The contractor maintained Carbic lights for emergency at this plant as on all other sections of the job. For regular lighting at the sand plant, a Universal engine with a G-E generator was housed next to the office away from the main plant.

Water Supply from North Side of Canal

In order to furnish an adequate fresh water supply, for the Cape Cod Canal is salt water connecting Cape Cod Bay and Buzzards Bay, the contractor tapped Nightingale or Flax Pond behind the hill on which the north abutment of the Bourne Bridge stands and carried water in a 6-inch pipe with Dresser couplings to the Canal and then through a pair of 4-inch pipes laid on the bottom of the Canal. A Domestic triplex pump supplied water to the line from the pond.

The manner in which the pipe line was laid across the Canal is ingenious. The first step was the making of an accurate cross section of the Canal at the point of crossing from soundings to determine the actual length of pipe which would be necessary for the subaqueous crossing. The 4-inch pipe in 20-foot lengths was coupled with Fons flexible joints. A ⅝-inch steel cable was run through the pipe and attached to a wooden block at the shore end. The canal end was attached to a plank mounted on three empty oil drums as a float so that it would be above water and not fill the pipe with sand from the canal bed during the pull across the channel. This mounting is shown in one of the illustrations. At a low tide, and when no traffic was passing through the Canal, the pipe was pulled across by attaching a cable to an Industrial Brownhoist steam crane. The total length of the pipe from shore line to shore line was 520 feet.

The Contractor's Office

In order to furnish adequate facilities for the con-

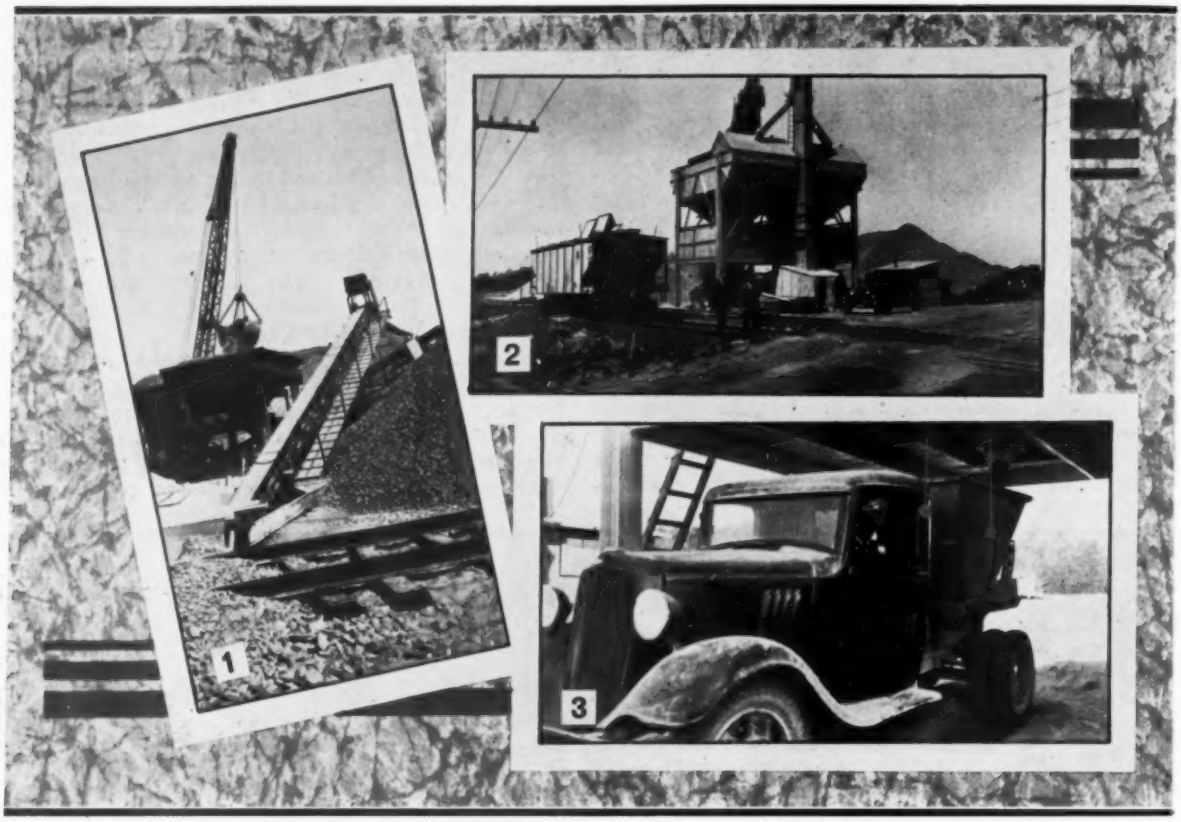
tractor's construction staff, engineers, and office manager, an all year round house located near the North Bourne piers and close by Buzzards Bay was secured. The six rooms provided adequate office facilities for the contractor's staff and for visiting equipment and material men. Inasmuch as work was continued through a large portion of the severe winter of 1933-34, the adequate housing facilities were appreciated by the staff.

THE TYPICAL BATCHING PLANT AT NORTH BOURNE

Alongside the double spur from Buzzards Bay, a pair of Butler bins, Model X100, was set up. Crushed trap rock from the quarries of the Old Colony Stone Co., Quincy, Mass., was delivered by hopper-bottom cars to a hopper beneath the northerly track. From this hopper the stone was removed by an 18-inch Barber-Greene belt conveyor 70 feet long with a chute at the upper end, making it possible to deliver the stone beyond the main conveyor to storage or directly onto the 24-inch belt of the 155-foot Barber-Greene conveyor which carried the stone or sand to the three-compartment Butler bins. Material delivered to storage was rehandled by a Moore Speedcrane and clamshell bucket to the stockpiles or to a wooden feed bin which regularly delivered sand to the 155-foot conveyor as needed and which could also be used to deliver stone when it was handled from stockpiles. For normal operation, stone was handled direct from the cars to the bins, but when the 200-yard per hour pour was in progress, it was necessary to use stone from the stockpile as well. The 155-foot belt could readily handle 400 tons of aggregate per hour. At its upper end was a chute which could be swung to deliver to either of the two outer compartments of the two bins. Cement was stored in the two compartments of each bin adjacent to each other, stone in the middle compartment and sand in the outer compartment to prevent any possibility of

PLANT AND PERSONNEL ON THE CAPE COD HIGHWAY BRIDGE CONTRACT

1. A 35-ton crane with 65-foot boom which had just arrived at the North Bourne yard from South Sagamore. Pavers, cranes and other heavy equipment were moved daily with this truck-tractor and machinery trailer. 2. The extra unit of the batch truck fleet was used frequently by the truck foreman as a service truck. 3. S. Bonelli, Superintendent for P. J. Carlin Construction Co. 4. (Left to right) A. R. McLean, Junior Engineer, Corps of Engineers, U. S. A., H. P. Dunbar, Associate Engineer, Corps of Engineers, U. S. A., and Paul Jones, Expediter for P. J. Carlin Construction Co. 5. Driving 65-foot steel sheet piling at North Sagamore by the Blakeslee-Rollins Corp., subcontractor for the cofferdams for the four main channel piers. 6. The fleet of four truck-mixers which hauled concrete for some of the operations.



THE NORTH BOURNE AGGREGATE HANDLING AND BATCHING PLANT

1. The track hopper is in the foreground with the 70-foot belt conveyor delivering aggregate to the 155-foot conveyor which extends from beneath the wooden hopper diagonally upward to the right. 2. The twin batching plants with the end of the 155-foot conveyor shown above them and a bulk cement car at left. 3. One of the fleet of single-batch trucks with gravity-dump bodies being loaded. Note the two rubber balls which help the driver spot the truck beneath the batcher.

dampness reaching the stored bulk cement.

The Lehigh or Universal Atlas bulk cement was delivered on the southerly spur track in hopper-bottom tank cars from the track hopper by two horizontal Rex screws to the bottom of the Rex vertical bucket elevator.

The following table gives the specifications for the three classes of concrete used and typical weights of the aggregate and cement:

Class A	Minimum strength allowed—3,000 lbs. per sq. in.	Slump 6 inches
	Cement	585 lbs.
	Sand	1,340 lbs.
	Stone	1,890 lbs.
	Water	5¾ gals. per sack
Class B	Minimum strength allowed—2,000 lbs. per sq. in.	Slump 6 inches
	Cement	515 lbs.
	Sand	1,300 lbs.
	Stone	1,900 lbs.
	Water	7 gals. per sack, maximum
Class C	Minimum strength allowed—2,000 lbs. per sq. in.	Slump 4 inches
	Cement	415 lbs.
	Sand	1,300 lbs.
	Stone	2,080 lbs.
	Water	7 gals. per sack
	The stone weighed about 2,500 lbs. per cubic yard	
	The sand weighed about 2,700 lbs. per cubic yard	

Tests have been much higher in strength than the minimum specified. The quantities of water and the slumps are maxima and were much less in practice.

All the batches were hauled by one-batch Chevrolet trucks equipped with 2-cubic yard Easton Rollover bodies. Two rubber balls on strings, as illustrated, were set under the batchers to spot the trucks. The driver set the truck to receive the stone and cement at the same time and then moved ahead to the next ball to receive the sand on top. A bell sounded by the batcher man notified the truck driver when to move ahead so that progress through the batcher plant was rapid. In fact, it required about 26 seconds to load each batch.

CONCRETING THE INTERMEDIATE PIERS WITH ONE OR TWO PAVERS

The concreting of Pier No. 6 at North Bourne, as shown in the illustration, is typical of one of the concreting methods used by the Carlin organization on these bridges. On some of the piers sheeting was not necessary as the ground stood up well. On Pier No. 6, however, some sheeting was placed to prevent caving. Then bents of 12 x 12-inch timber with caps were set up, carrying a pair of 26-inch H-beams, of sufficient length to span the excavation at its shortest diameter. The H-beams were laid with the flanges vertical and the upper space filled with timber to provide a pair of runways for the crawlers of the 27-E pavers.

The Chevrolet trucks drove up over the well-maintained gravel road, delivered their single batch to the skip of the paver and hastened away to the batching plant. After a 1½-minute mix, the concrete was delivered direct from the paver drum into one of a pair of hoppers in cantilevered frames outside the pair of

H-beams. From these hoppers the concrete was dropped through a series of funnel-shaped chutes each suspended from the section above and sufficiently flexible to permit concrete to be delivered over a wide area. The concreting crew at each pier consisted of a foreman, the skip man, the paver operator, one man at the top of the chute, two men swinging the chute and four men in the pit spading.

This method of concreting provided great flexibility, as for example, at Pier No. 6, two pairs of H-beams were laid across the pier excavation and one 27-E paver run out on each. Had the pier been wider, the contractor would have placed two 27-E pavers facing each other on each pair of H-beams and thereby doubled the rate of pouring. Under normal conditions, one 27-E paver with the average haul of a little more than ⅛-mile from the batching plant and with a 1½-minute mix could deliver 25 to 30 cubic yards of concrete to the forms per hour and this rate could be doubled, trebled or quadrupled merely by adding one or more pavers over the pier.

FORM WORK AND CONCRETING ABUTMENTS

The abutment at North Bourne is typical of the form work used throughout the project on all abutments and piers and the concreting method is typical. Panels made up of 1 x 8-inch tongue-and-groove-lumber dressed on one side and made up in 42 and 43-inch widths, 10, 12, 14 and 16-feet long were used. The specifications required the use of the rough side of the lumber against the concrete. On certain outside faces forms were lined with 4 x 8-foot panels of plywood with the joints exactly horizonal and vertical. The vertical studs were 2 x 6's and the wales 7 x 8's doubled with the bolts between the two planks. The general spacing of the bolts was on 4-foot squares and the first wale was carried 1 foot from the bottom.

All of the staging was carried on the inside of the abutment pylon which measured approximately 34 x 75 feet in plan. The walls varied from 4 feet 8 inches to 2 feet 4 inches in thickness. The ties were 1-inch diameter bolts with couplings and 1-inch diameter bolts at either end which were backed out after the concrete had set. The outer 1-inch bolts were approximately 17 inches long in order to extend 1 inch into the coupling which was 1 inch from the inside of the panel and held by 1-inch blocks. The panel itself was 1-inch thick, then the 6 inches of the stud and the 8 inches of the wale, making a total of 17 inches through which the outer bolts extended. All forms were cleaned with a wire brush as soon as stripped to remove all adhering concrete and were oiled at once and stacked face down. When the forms were first made, they were completely dipped in an oil bath.

The pouring of concrete for the North Bourne abutment was handled by a Foote 27-E paver equipped with

POURING CONCRETE WITH PAVERS AT PIER 6, NORTH BOURNE

1. *Delivering a single batch load to one of the pavers run out over the pit on H-beams. The second paver is seen just over the top of the cab of the batch truck. 2. A close-up of the paver showing the two flexible chutes, the bents supporting the H-beams and the top and pit crews. 3. The battery of pumps required at Pier 6 to keep the water down in the glacial drift during the pouring of the footing.*

THE CENTRAL MIXING PLANT AT SOUTH SAGAMORE

1. The mixing platform, showing two pavers in operation. 2. The front of the plant, showing the two pavers and also the non-tilting mixer mounted in the center below the platform, the two chutes from the pavers, the control hoppers and one of the fleet of agitator trucks being loaded.

a Lakewood tower. A similar method was used at South Bourne and North Sagamore on the abutments, using this same paver or an Insley tower mounted on a Smith 27-E paver. At South Sagamore, a Smith 27-E paver at roadway level delivered the concrete to one of the twelve Koppel side-dump hopper concrete buckets which was handled by a Koehring crane lifting it to a hopper mounted on the forms.

The contractor used four Jackson vibrators on footings and experimented with them in the walls which were heavily reinforced with round rods, the placing of which in the South Sagamore abutment, adjacent to the existing roadway which will travel beneath an arch, is shown in the illustrations.

PRODUCTION MOST IMPORTANT IN POURING MAIN CHANNEL PIERS

Mean water in the Canal is at datum 100 and it was necessary for the Blakeslee-Rollins Corp. to drive the steel sheet piling for the Bourne piers to 48 and the Sagamore piers to 46, using a McKiernan-Terry double-acting pile hammer. Each of these main channel piers measures approximately 108 x 50 feet in plan. Considerable difficulty was experienced in driving the cofferdams because of boulders. Upon completion of the cofferdams, and their excavation by clamshell, a mat of concrete about 25 feet thick was placed over the entire bottom. This mat required special organization and equipment as each of the four consisted of approximately 5,000 cubic yards of concrete placed by submarine buckets at the rate of 200 yards per hour with continuous pouring to prevent any line of cleavage due to laitance. This rate of pouring is comparable to Boulder Dam production. No placing of concrete by tremie was permitted.

The flexibility of operation has already been brought out in the description of the pouring of intermediate pier No. 6 at North Bourne with pavers mounted over the skips on H-beams, and the use of single pavers with towers or delivering to side-dump concrete buckets handled by cranes. The next feature of concreting is the central mixing plant, so called, two of which were erected, one at North Bourne and one at South Sagamore. The North Bourne plant not only furnished concrete for the main channel piers at that location but also mixed all of the concrete for the Blakeslee-Rollins contract.

The central mixing plants were in themselves particularly flexible. They consisted of a sturdy framework of heavy timber, as pictured, carrying a platform of 2 x 12 timber, measuring 40 x 78 feet, supported on 26-inch girders and carried at a sufficient height to permit the chuting of concrete from the S-28 mixer mounted just beneath the platform into the fleet of four Jaeger agitator trucks, which were used for handling the concrete from these plants, as well as the concrete chuted from two 27-E pavers which were run on to the top of the platform and delivered the mix to the hopper from which concrete was run into the agitator trucks. If only a small quantity of concrete was needed, or needed at a low rate, it was necessary to operate only the single Koehring or Smith S-28 mixer located beneath the platform. If a larger volume was needed, one of the four 27-E pavers, of which there were three Smith pavers and one Foote, could be run onto the platform or, for maximum production, two 27-E pavers and the S-28 mixer were operated simultaneously. Two of the photographs furnished through the courtesy of P. J. Carlin Construction Co. show the mixing platform at South Sagamore from the charging end and also from the discharge end. The rate of production of concrete from one of these central mixing plants with the two pavers and the mixer operating ran well above the rate required by the specifications for pouring the 5,000-cubic yard monoliths of the main channel piers.

LUBRICATION SCHEDULE

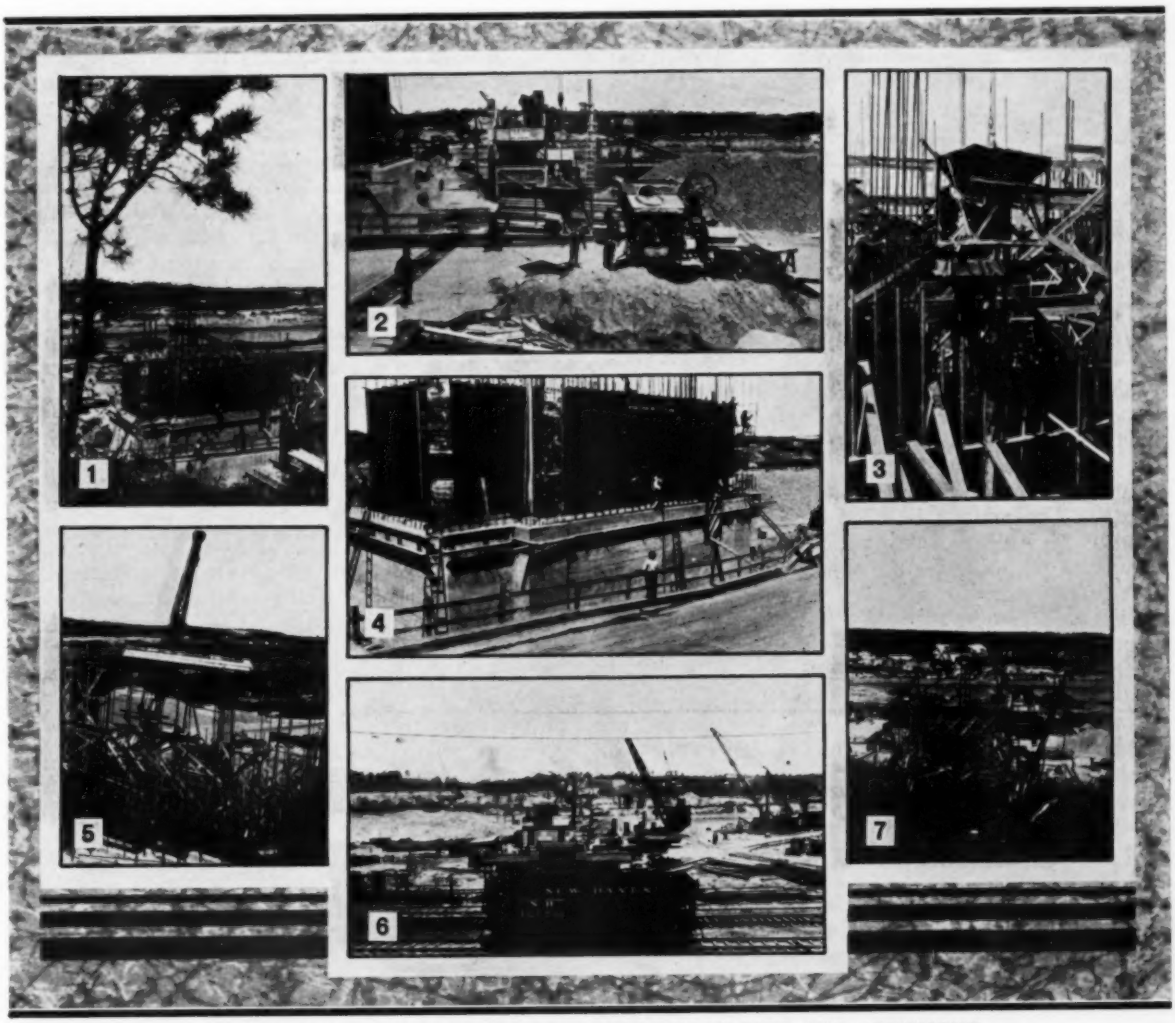
All of the motor equipment on the job was under the direction of a foreman who was completely responsible for the truck drivers and equipment. He had authority to hire and fire drivers, but with care first in their selection and then in their training, there was seldom need to discharge any of the men. Each Sunday morning the men were required to clean and grease the trucks and change the oil and then run the trucks

up on a ramp for the foreman to inspect. This enabled him not only to see that lubrication was complete, but also to note any damage to the underbody of the trucks which could not readily be checked in any other manner. An electrically-operated lubrication gun was installed at the North Bourne truck shop.

The contractor, in addition to operating the twelve Chevrolet trucks with Rollover dump bodies and four Jaeger rear-dump agitator bodies mounted on Mack trucks, had a Mack truck tractor and machinery trailer which was used to move any piece of heavy equipment quickly from any one of the four sites to another.

PERSONNEL

The substructure contract for the two Cape Cod highway bridges was awarded to P. J. Carlin Construction Co. on its bid of $1,327,700.00. For the contractor, this Federal Public Works Project 26/36 was under the active direction of J. P. Carlin, President, and S. Kent, Chief Engineer, with S. Bonelli as Superintendent, M. T. Staples, Resident Engineer and Paul Jones, Expediter. For the Corps of Engineers, U. S. A., the work was under the direction of Colonel J. J. Kingman, District Engineer, assisted by Capt. R. C. Hunter, Lieut. P. P. Goerz, Corps of Engineers, and Capt. H. L. Colbeth, Superintendent, Cape Cod Canal, and Associate Engineer H. P. Dunbar. Fay, Spofford and Thorndike, Boston, Mass., were Consulting Engineers to the Corps of Engineers on the highway bridges and were responsible for the design and supervision of construction, with C. A. Farwell as Partner in charge and Allan Beale, Resident Engineer. The subcontract of Blakeslee-Rollins Corp. on the cofferdams for the four main channel piers was in the charge of Walter Cheever, General Manager, and R. J. Reigeluth, Assistant Treasurer, with William H. Ryan as Superintendent.



OPERATIONS ON THE SOUTH SAGAMORE PYLON PIER AND ABUTMENT

1. The South Sagamore pylon pier, showing one of the concreting towers. 2. A paver and concrete hopper furnishing concrete for the abutment walls. The South Sagamore batching plant is shown in the background. 3. The hopper shown in Illustration 2 delivering concrete to the wall forms. 4. Form work and placing reinforcing for pylon Pier 5. 5. The crane handling form lumber for the abutment. 6. A view across the canal from the mixing plant showing South Sagamore yard and office. 7. The work at North Sagamore across the canal as seen from the top of the South Sagamore hill.

An Effective Batching Set-Up *for* Industrial Railway Haulage

Vinton Construction Co. Worked Out Economical Method for Handling Materials

WITH a spur track paralleling the right-of-way of the highway to be paved, the Vinton Engineering Construction Co. of Coldwater, Mich., made the most of the opportunities offered by the location for batching the aggregates and hauling with an industrial railway outfit. Two pits were dug under the railway track for dumping the stone and sand and between them the two Johnson batching bins were located. The contract required two sizes of stone and sand in the batch so one bin was used for two sizes of stone and the other for the sand.

A Speedcrane with a 45-foot boom and a clamshell bucket unloaded the aggregates from the pits and maintained the bins full of aggregates by moving parallel to the tracks and clamming over the industrial railway track to reach the pits. It also kept two stockpiles of stone and one of sand well supplied. One of the stone stockpiles ran over onto the right-of-way of the road which was being paved so that when the paver reached that section it was necessary to use from that pile until the grade was cleared. This was done and the stockpile refilled as soon as possible against any failure of the regular supply.

The trains of 21 Lakewood cars and two batch boxes to a car were made up with the first two cars near the 8-ton Milwaukee locomotives carrying the batch boxes and the third a flat car to carry four barrels of batched cement. Thus every third car for the entire train was a flat car of cement. The train pulled through under the first batching plant and received the first of the aggregates and then through the second where the loading was completed. It then pulled along the line to the cement dock where the four barrels of batched cement were loaded on the flat cars.

At the paver the batch boxes were handled by the usual short boom derrick of the paver and swung over and dumped by two men into the skip. The handling of the cement barrels was of particular interest. These barrels, made of old oil drums and with short collars at the top to give them the proper capacity without spillage, had axles run through at about one third the height from the bottom and the metal of the barrel reinforced with a cleat from the bottom up the side.

The paver pushed a bridge ahead which spanned the 20-foot pavement and which was about 12 feet wide. In the center of this bridge a hoist built of structural steel was erected with an I-beam horizontal member at the top on which a trolley ran toward the skip. The hoist was swung toward the flat car, a barrel of cement picked up and raised with the chain falls on the trolley and the whole swung toward the paver skip just as the batch box was swung away. This required the services of two men just as the batch boxes required two. Two pipe connections from the paver to the hoist bridge kept the bridge at a constant distance from the paver so that the hoist always operated with constant effectiveness.

We are indebted to W. U. Vinton and E. C. Dreyer of the Vinton Construction Co. for the information on which this article is based.

What's being done in the construction industry today? Coming issues of CONTRACTORS AND ENGINEERS MONTHLY *will contain unusual and outstanding articles on jobs now under way or completed this summer in the south and southwest, prepared by the Editor after personally visiting this work. Included will be articles on various types of paving, bridge and overpass construction, levee work, an account of methods and equipment used on the Norris Dam—all of which will offer the reader instructive information on the methods used by other contractors and the latest news on active work in the construction field.*

The Lubrication *of* Mixers, Pavers and Finishers

The Ninth of a Series of Articles on an Important Phase of the Maintenance of Construction Equipment

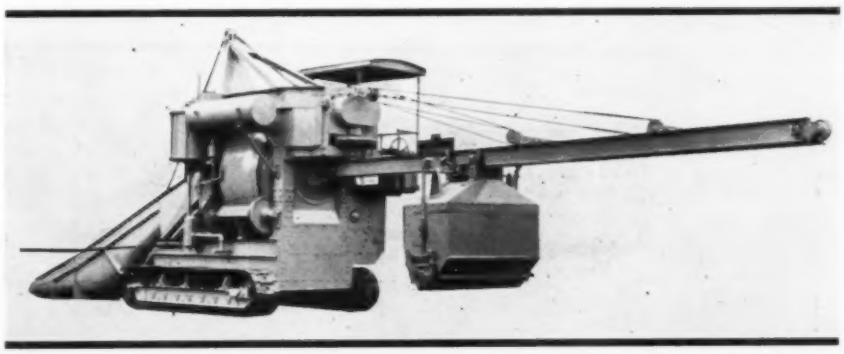
CONCRETE mixers, pavers and finishers have a greater number of bearings than any other unit or combination of units used for a given purpose among contractors' equipment. They are sufficiently diversified as to warrant the statement that these machines utilize every type of bearings which has been mentioned in preceding articles, though their operation varies somewhat due to conditions under which the machines operate in service, and the duty they perform. These operating conditions possibly do not involve as heavy duty as some other units, but the character of material handled makes their efficient lubrication of utmost importance. Invariably many of the bearings are completely covered with concrete when the machine is in operation and extreme care must be exercised when applying lubricants to the bearing parts to see that cups and fittings are thoroughly cleaned, to forestall the possibility of gritty or abrasive substances being carried to the bearings with the lubricant, which would cause unusual heating of the bearings, within a short period grinding them out and necessitating replacements at an excessive expense. Accumulated concrete should not be permitted to remain on machines after being shut down at noon and at night, but should be washed off thoroughly with a hose at these periods, at which time such lubricant as may be necessary should be applied.

The lubrication for the engines operating these units have been discussed in previous articles. The instructions contained in the instruction books of the engine manufacturer should be the operator's guide in the selection of the grade of oil to be used during the summer and winter seasons.

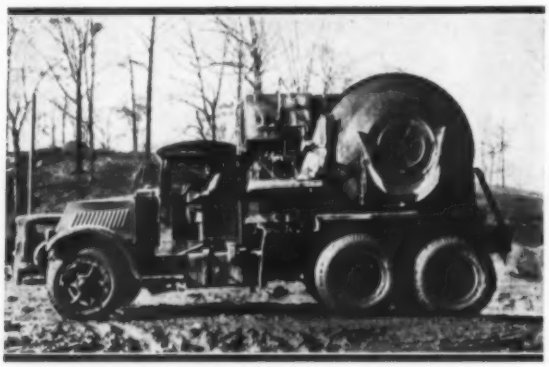
A Rex 14-S Mixer Pouring a Culvert—Typical Service Required of the Smaller Portable Mixers

The Lubrication of the Bearings

There are many makes and types of mixers, pavers and finishers, but the principles involved in their operation are quite similar insofar as bearing construction is concerned. Roller and ball bearings are extensively employed throughout the machines and are rapidly replacing plain sleeve bearings wherever unusual duties are being performed and construction costs are not a factor in their adoption. These require the best grades of grease lubricants to conserve their life and not defeat



A MultiFoote 27-E Paver in the Pristine Condition in Which Construction Equipment Is Shipped from the Factory



The New Jaeger Side-Discharge Truck Mixers Have the Combined Lubrication Requirements of the Motor Truck and Mixer

the purpose of their adoption: the elimination of friction to the fullest possible extent. Under no circumstances should a lubricant containing fillers of any description be used for this purpose, as they are not lubricants in any sense of the word. On the contrary they invariably contain abrasives in one form or another which are used in the inferior class of greases for weight-making purposes. They tend to cause excessive wear of the bearings and necessitate early replacements. Only a small quantity of grease lubricant is required for the lubrication of bearings of these types and the slight difference in the cost of the more favorably known brands justifies their adoption and regular use by the operator.

Care should be taken in selecting the proper consistency of lubricant to be used. It should not be too heavy as to retard the free action of the rollers or balls nor should it be of so light a consistency as to prevent its adhering to the bearings and "staying put" until it has finished functioning as a lubricant. A lubricant no heavier than a No. 2½ density nor lighter than a standard No. 2 density should be used for this purpose. These are the consistencies of well-made standard pressure lubricants.

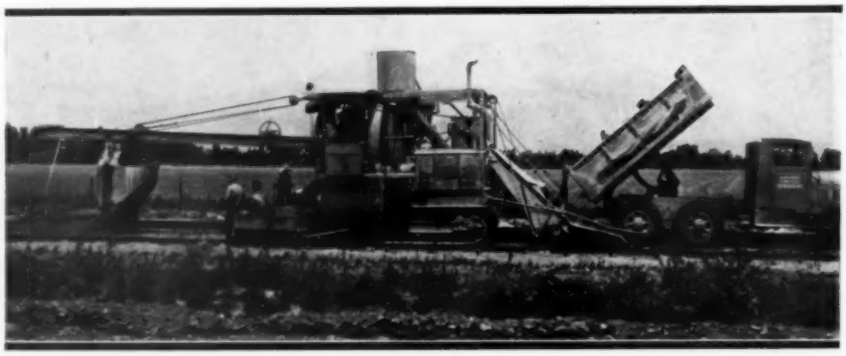
Plain or sleeve-type bearings are constructed and equipped for grease lubrication, with but few exceptions. The more modern machines have pressure fittings installed as a medium for the introduction of the lubricant to the bearing surfaces, the lubricant being dispensed with a hand gun or mechanically-operated pressure machine. A consistency of lubricant such as is recommended for roller and ball bearings may be handled easily with the dispensing equipment mentioned. Heavier lubricants should be avoided if possible as they require a greater force for applying and there might be a tendency on the part of the oiler to curtail the application, to the detriment of the bearings. All bearings of the type last mentioned should be lubricated daily to insure constant lubrication and to maintain a seal of lubricant at each end of the bearings to protect it against moisture. A calcium-base lubricant should be used as it is less susceptible to emulsification than the sodium-base greases.

Oilless bearings are being used to a considerable extent in machine construction and frequently the name implies to the operator that they do not require lubrication. However, each of these bearings is equipped with either a filler plug or pressure fitting and require lubrication at stated intervals. When filler plugs are installed a small quantity of oil should be applied at least once a week. When equipped for grease lubrication, the lubricant should be applied in small amounts every two weeks.

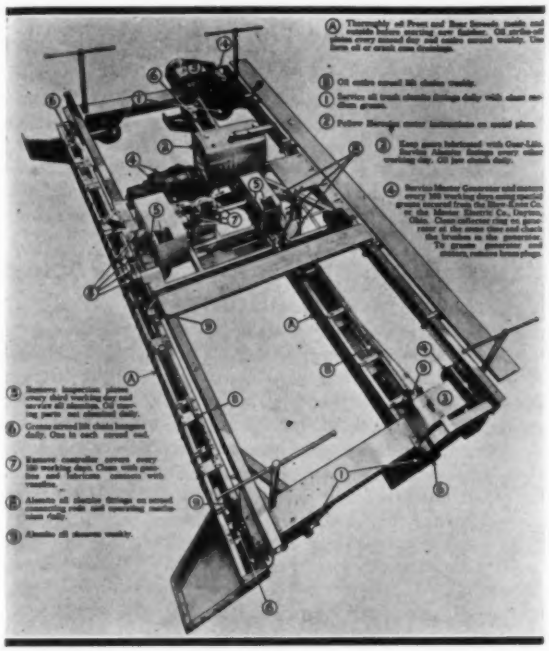
Open Gears Require Special Care in Cleaning and Lubricating

The equipment discussed in this article employs many open gears which should be lubricated with a medium-consistency plastic and adhesive gear grease of the calcium or residium type to protect the teeth of the gears against wear and corrosion. These gears operate under conditions which subject them to considerable dust, dirt and moisture and it is time well spent to clean the teeth of the gears at the points of contact before making a fresh application of the lubricant, that all grit and abrasive substances may be removed. The lubricant should not contain pine tar or similar products which are used to create a greater adhesiveness, as these have a tendency to increase the friction load to a considerable extent, thereby increasing fuel consumption. A type of gear lubricant known as "gear shield" has gained more or less popularity for the protection of gears, but these entail the disadvantage of having to be heated to apply satisfactorily and should they set too hard after application they are apt to chip off, leaving the face of the gears exposed to undue wear. This is particularly true when used during the colder months. The gear lubricant should be applied daily to insure a sufficient protective film on the teeth at all times.

Reduction gears, when enclosed in oil-tight cases, should be lubricated with a fluid lubricant which will flow freely and at the same time be sufficiently adhesive to maintain a protective film between the contact points



Out on the Job, Cement, Dust and Concrete Complicate Lubrication Problems —A Well-Maintained Koehring Paver Working in Wisconsin



Directions for the Lubrication of a Blaw-Knox Electrically-Operated Finishing Machine

while in operation. A good grade of steam cylinder oil is a very satisfactory lubricant for this purpose. It has good lubricating properties and its cost permits of frequent changes. Lead-base lubricants have popularized themselves in recent years in the industrial field for this purpose. A well-made lubricant of this character has exceptional lasting properties and forms a cushion between the teeth of the gears which protects them from excessive wear and reduces noise to a minimum. It is necessary to replenish this lubricant only at infrequent intervals, providing the cases are kept tight. Regardless of the lubricant used the case should not be filled above the overflow plug.

All moving parts not equipped with means for lubrication should be hand oiled with a few drops of oil, the frequency of lubrication depending upon the amount of movement of the particular parts and special operating conditions.

Special Features in the Lubrication of Finishing Machines

Special attention is called to the lubrication of finishing machines as it is most important they be thoroughly lubricated at frequent periods: oil strike-off plates of screeds every other day and the entire screed each week. Reclaimed crankcase drainings may be used for this purpose. To prevent corrosion, the screed lift chains should be thoroughly oiled semi-weekly and the hangers daily. All bearings equipped with pressure fittings should be lubricated daily when the machine is in operation. If generators and motors are of the ball-bearing type, they should be lubricated with the best grade of lubricating grease every 90 to 100 working days. If they are equipped with ring oiling bearings a high grade oil should be used, inspections made every three days and the lubricant kept to the full level.

The Use of Vibration in Finishing Concrete Pavement

TO investigate the possibilities of a vibratory finishing machine, a test section of 20-foot concrete pavement, 4,969 feet long, was built near Fisher, Ill., in 1933. The machine used was a double screed Lakewood, the front screed carrying four electric vibrator units and the rear screed carrying two units. The screeds were operated in the regular way, the vibratory motion being imparted to them while in action. The test section was made up of 114 individual sections of about 45 feet each, covering three series of progressively changing mixes for both gravel and crushed stone coarse aggregate. In one series, the water was the major variable, in one the coarse aggregate, and in one the fine aggregate. The mixtures were varied to determine the practical limits of the machine in finishing various mixtures.

Satisfactory pavement was obtained from most of the mixtures, even the harshest being placed satisfactorily. The most suitable mixtures had about ½-inch slump and had a ratio of sand to total aggregates by absolute volumes of 32 per cent for gravel and 35 per cent for crushed stone. With this method of finishing, higher strength was secured with the same cement content as the regular mixture, or the same strength as the regular mixture was secured while reducing the cement content approximately one bag per cubic yard of concrete.

A detailed description of the construction and tests, tables of data and figures and several photographs are contained in Report No. 33-1 of the Bureau of Materials, Illinois Division of Highways.

Delivering Equipment by Barge

ALL of the equipment used by the National Construction Co., Inc., of Tia Juana, Mexico, on its 70-mile highway from Ensenada to Tia Juana, including tractors, scrapers, bulldozers and similar units, was shipped by trucks and by railroad from points in California to San Diego, Calif., where it was reloaded on a marine barge and towed from San Diego to a point 12 miles north of Ensenada in Mexico. The barge was brought in to the beach at high tide in such a fashion that when the tide went out, the barge was left high and dry. A ramp was constructed from the edge of the barge to the shore line over which all the equipment was removed. The total load was over 200,000 pounds, all of which, with the exception of the Lorain shovel, was handled by two Model 80 Cletracs, for both loading and unloading.

ROUGH GOING DOWN ON THE LEVEES

A Caterpillar wide-gage diesel Fifty and a 7 to 8-yard crawler wagon hauling from a 1¼-yard dragline on the Sam Hunter levee contract at Elane, Ark. The contractor reports a fuel consumption of approximately 2½ gallons per hour for this unit.

Some of the Heavy Excavation in the First Main Contract at Grand Coulee Dam

Progress at Grand Coulee

FROM the tip of the Continental Divide, where a drop of water might be turned by a stone to go on its way either into the Pacific or on to the Atlantic, the great river of the Northwest, the Columbia, twists its way to the West Coast. It is 1,400 miles from its source to its mouth, and in that distance, its water drops 2,500 feet. In furtherance of man's ambition to use nature to the fullest extent, a combination power dam and irrigation and reclamation project is under way at the upper end of the Grand Coulee on the Columbia in central Washington. This project, one of the greatest ever attempted by the Federal Government, will cost $393,000,000, payment of which will be over a period of 50 to 75 years.

The Grand Coulee is a narrow 30-mile gash, lying between vertical granite cliffs 400 to 600 feet high, with a level and water-tight floor. It is a natural reservoir which, when dammed, will irrigate by gravity more than a million acres of land lying in a great half moon below the Coulee. An additional 200,000 acres will be irrigated by pumping. The water impounded here will be used to develop over 2,400,000 horsepower.

Present plans, however, call only for a $63,000,000, 3,430-foot power dam on which the preliminary work has already begun. The first main contract calls for 2,000,000 cubic yards of common and 40,000 cubic yards of rock excavation. The low bid of $534,000 was submitted by David H. Ryan of San Diego, Calif. A major part of this contract was sublet to Goodfellow Brothers, of Wenatchee, Wash. The 2,040,000 yards of dirt and rock must be moved within 150 days from January 1, 1934, and a penalty of $1,000 was fixed by the government for every day required by the operations over that time. For this reason, speed and efficiency are paramount with the contractors.

The excavation is handled by large Bucyrus-Erie and P & H gasoline shovels loading to International trucks, with 8-yard dump bodies. In addition to the trucks already owned by Goodfellow Brothers and their subcontractor, D. A. Whitley, ten new Model A-8 International trucks were purchased for the job. The average length of haul for each truck is about ¾-mile round trip, and each truck makes an average of 125 trips daily. Operation is continuous, the trucks being on a 20-hour-a-day schedule. Time is taken out only because of the three shifts of drivers, who work 6 hours and 40 minutes per shift. During their off hours, the trucks are carefully checked for oil and grease so that there will be no delay for servicing during working hours. The going is difficult, as the trucks make their own roads as they haul from the shovel to the dumping pit. Sometimes they must make their way through soft sand or hub-deep mud and sometimes over rocky, rough terrain.

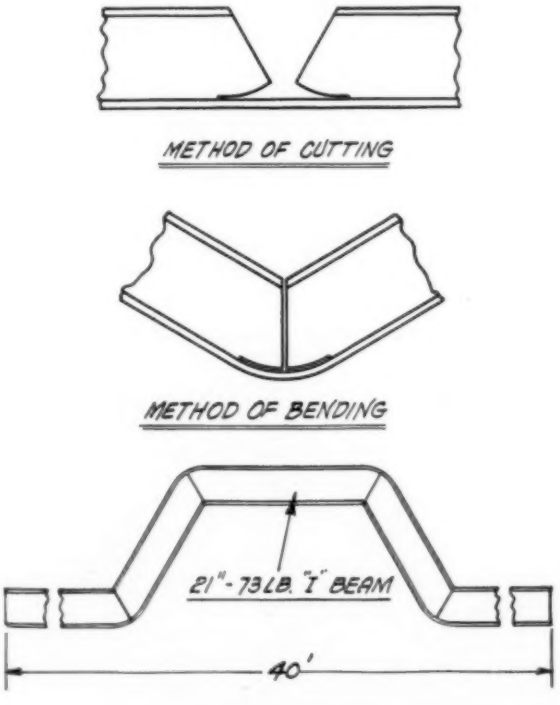
Despite these and other handicaps, excavation has proceeded most satisfactorily and with a little more than a third of the contract time expired, over half the excavation was completed.

The total excavation necessary for the project will be over 17,000,000 cubic yards of earth and rock. This is necessitated by the plans which call for a concrete dam 4,100 feet long and 370 feet high. This huge piece of construction will contain nearly 11,000,000 cubic yards of concrete and will create a lake 151 miles long, reaching north to the international boundary.

Welded Monitor Frames for World's Fair Building

ONE of the new features of the 1934 Century of Progress Exposition at Chicago is the Ford Building which was constructed of one-piece arc-welded monitor frames. The north wing of the building, which houses the Ford Industrial Exhibit, has three bays with monitor roof construction. In order to eliminate the maze of steel work presented by built-up monitor roof trusses, the architect dispensed with trusses and used in their place continuous 21-inch I-beam monitor frames. These frames were formed by cutting triangular notches through one flange and the web of the beam with the desired radius cut in the web above the other flange as shown in the illustration. The beams were then bent to the proper shape and, with a reinforcing strut on each side of the web, were welded with a ⅝-inch extra heavy bead.

Fifty-eight monitor frames 40 feet long were built by this method by the R. C. Mahon Co., Detroit, Mich., who received the steel contract. Six small frames built of 12-inch I-beams were constructed in the same manner. All welds were made in position, using ⅜-inch weld electrodes and Lincoln shielded arc welders. This building is an excellent example of modern structural design. The building proper is 900 feet long with a central rotunda 110 feet high. The welded frames provided an important saving in steel as well as in construction.



Sequence of Operations in Making the Monitor Frames for the Ford Building

Copper Mine Waste Used as Sheet Asphalt Aggregate in Northern Michigan

A View of the Mixing Plant Showing the Stamp Sand Stockpiles

By
A. P. Hanan
Detroit Asphalt Paving Co.

IN the copper district of Michigan's upper peninsula are vast accumulations of that by-product of the copper industry known as "stamp sand." Copper-bearing rock, as taken from the mines, is sent to the stamping mills and is then crushed. The free or mass copper is then removed by mechanical methods and the remaining small particles of rock, called "stamp sand", are disposed of by washing into a dump, or by regrinding to a much finer consistency and treating with chemical to reclaim the remaining copper content. This latter material is known as "reground stamp sand."

Many and varied attempts have been made to utilize stamp sand in road building. It has been used as a wearing course mixed with clay or binder, and as a mulch or cover course on a gravel or macadam road. It has also been used as fine aggregate in cement concrete pavements and structures. Its use as a mineral aggregate for sheet asphalt paving was considered, and samples were sent to the Michigan State Highway laboratory for experimentation.

The results obtained in the laboratory were very favorable. In fact, the stability of the mixes was so much greater than those obtained with the use of bank sand that the conclusion was drawn that something must be the matter with it. Rather extensive research was carried on in the laboratory for a period of years, and finally in 1932, the Highway Department decided to make some actual test in the field to determine the practicability of using stamp sand as a mineral aggregate in sheet asphalt pavement.

Accordingly, eight carloads of stamp sand and reground stamp sand were shipped from various sources in the copper district to a sheet-asphalt paving project in the process of construction. Test sections were laid, consisting of various mixes of each class of stamp sand or reground sand. Samples were taken from each section and analyzed thoroughly. All mixes using stamp sand gave favorable results. Mixes using reground stamp sand revealed a hardening effect on the asphalt and loss of ductility, presumably due to the presence of copper salt.

Test Projects

Based on results of this research, the Highway Department decided to construct several projects in the copper district and amended their specification to permit the use of stamp sand but not reground stamp sand.

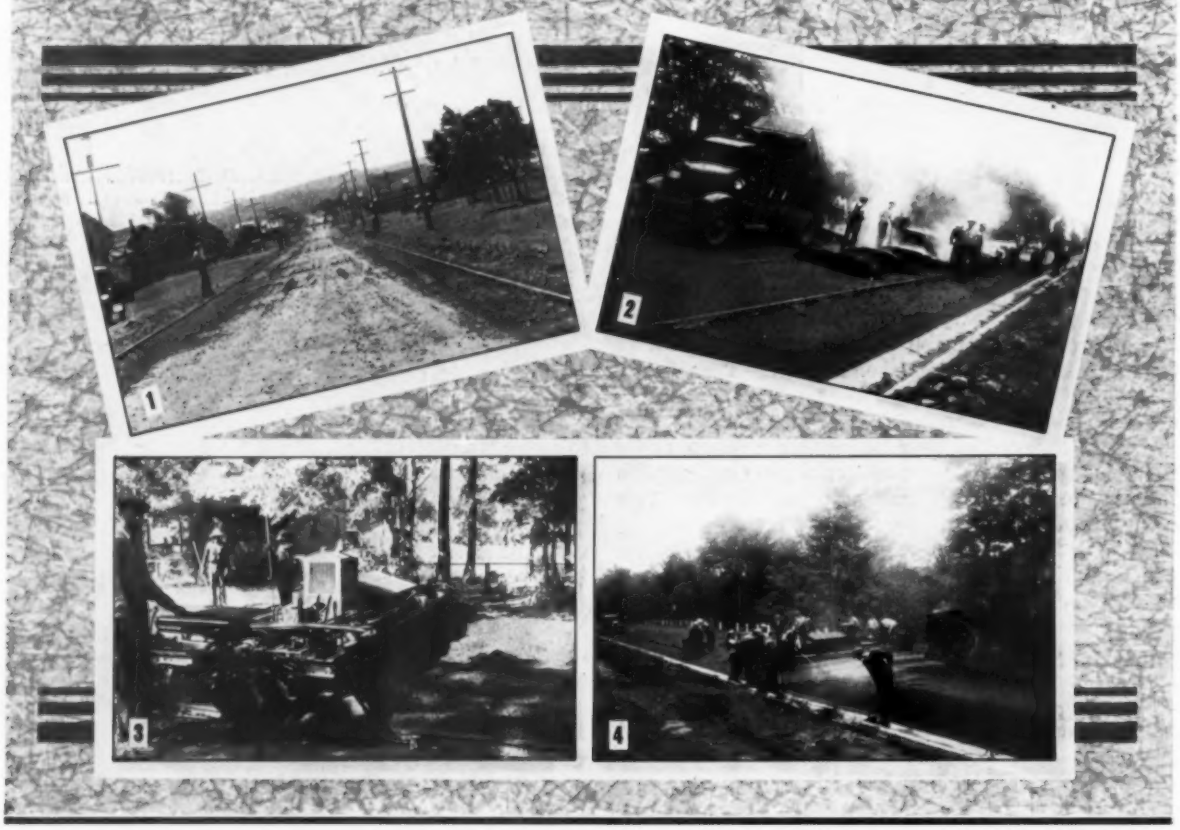
The contract, which included a little over 12 miles of paving on U. S. Highway No. 41, in and near Houghton, Mich., was let to the Detroit Asphalt Paving Co., of Detroit, Mich., and was completed on October 10, 1933.

The work consisted of removing the brick pavement and street railway tracks on the principal streets of Houghton and repaving with stamp-sand sheet asphalt. It included also removing the old asphalt wearing course and cutting off street railway tracks flush with the cement concrete base on the principal streets in Hancock and repaving with stamp-sand sheet asphalt. Both of these streets were 36 feet in width. Grades were established and 3-inch Blaw-Knox steel forms were securely fastened to the concrete base 10 feet each way from and paralleling the center line. An extra heavy Ord asphalt finishing machine equipped with a Le Roi engine, operating on the steel forms screeded the binder and stamp-sand sheet asphalt wearing course over the center 20-foot area. The forms were immediately removed after the finishing machine had passed over them and the remaining area between the form line and the curb was filled in and finished by hand, after which the entire street was rolled and a monolithic surface obtained. The results of this method were two-fold: first, the main travel portion was machine-finished independent of the existing curb and gutter irregularities, which gave a smooth riding surface for traffic; second, in finishing by hand outside the outer 20-foot strip, it was possible to warp the pavement to meet all the irregularities of the existing curb and gutter. In the county, curves were widened and super-elevated to add to the safety and comfort of the riding public.

Stamp-sand particles are practically cubical in dimension and very angular or sharp. The sheet asphalt mixture, under the rake, develops a gritty feel as the tines pass through the mixture, quite different from the effect obtained in combing out or raking sheet asphalt top containing ordinary sand. To insure a gritty, anti-skid surface, dried stamp sand was very evenly and thinly spread over the surface immediately after the initial rolling, and then rolling was continued until final compression was obtained. In the judgment of many who have seen the completed pavement, the resulting surface is representative of the highest type of wearing surface.

Two other projects of approximately one mile each had curb on one side for practically their entire length. In this case the forms were set so that one form line was on the extreme edge opposite the curb line and the other form line 20 feet away from the outside form line and 5 to 6 feet from the curb. After the finishing machine had passed, the inside forms were then re-

(*Continued on page* 40)



REPAVING AND WIDENING U. S. ROUTE 41 *THROUGH HOUGHTON, MICHIGAN, WITH SHEET ASPHALT*

1. Steel forms laid on the existing stone base for the widened highway. 2. Delivering hot batches of sheet asphalt to the roadway and widening by warping into the curb and gutter by hand. 3. A mechanical finishing machine spreading the binder mixture. 4. A finished section of the widening strip ready for rolling, immediately behind the finishing machine.

The Editor Comments

Personal Observations and Reflections

Equipment Should Meet Specifications

State highway specifications cover the methods and results which are expected of contractors in their work. They also, with increasing frequency, describe by word and figure the equipment to be employed. Ingenious contractors and their superintendents are often able to develop their own devices for performing certain operations. Not infrequently state highway engineers have recognized the value of these devices and in the specifications of the following year have required that all contractors use a similar instrument. Manufacturers, quick to appreciate the merchandising value of some new piece of equipment developed by a contractor, have arranged to place it on the market through a national distributing organization, after suitable payment to the inventor for his ingenuity.

It frequently happens, however, that the inventive genius of the mechanic is too highly appreciated and a device is used on a job, with the permission of the resident engineer or inspector, which does not meet the specifications nor adequately perform its functions, merely because it was "home-made." If the device had been produced by a manufacturer and failed to meet the specifications, the contractor would be ordered to take it off the job, and would undoubtedly return it to his distributor or to the manufacturer.

We have often mentioned the overzealous inspector in these columns, the man to whom the wording of the specifications means more than its intent, or the result desired. There is a happy medium between this type and the engineer who is too slack in the interpretation of the specifications and who allows equipment or devices to be used which fail to perform their functions adequately.

An example recently came to our attention in a state where the specifications require a subgrade scratch template to weigh 1,000 pounds for a 20-foot width, or in proportion per foot for other widths, and with test pins spaced not more than 6 inches apart. The scratch template which the contractor made and used was a light beam mounted on two pair of small wheels and the entire device weighed between 175 and 200 pounds instead of the 500 pounds specificed for this 10-foot job. In further violation of the specifications, there were only eight pins spaced irregularly instead of the 19 or 20 required.

Far from discouraging the inventive genius of superintendents, foremen and mechanics in construction organizations, we most certainly would encourage the creation of devices which increase the ease of construction and its accuracy, but if specifications are worth anything, they should be followed scrupulously, and if they are worthless, the state or national organization should fight to have them erased as obstructive, useless and unnecessary. Let us have specifications that produce the desired results and let us live up to them. Otherwise, let us fight to be rid of them.

Collusion and Combination

What a small difference there is between collusion in bidding and simple combination bidding. A few months ago a remarkable bid for government work was thrown out because Contractor B who bid on Section 2 predicated his bid on Contractor A's receiving the award for Section 1. Similarly Contractor C said that his bid for Section 3 held only if Contractor B received the award for Section 2. This went on through five sections. No contractor can dictate through any combination whether the government may award his or another contract except through legitimate low bidding.

There is such a thing, however, as combination bidding which permits a contractor or group of contractors operating as one company or corporation to bid so that they may get the sections which they want and, by grouping the bids, rather definitely eliminate a section which they do not want. The difference is that the total figure for the sections or series of contracts they wish to secure must be lower in the aggregate than any other combination of separate bidders. With a definite agreement to loan or rent equipment which is already on the job, it is easy to understand why a group like this may be able to secure a favorable grouping of sections entirely fairly and within all rules of fair competition and codes of ethics.

The rulings regarding subletting parts of contracts have also tended to bring about the formation of groups of contractors able to swing the contract under one corporate name, but this is just another phase of up-to-the-minute bidding to keep away the wolf that is still sniffing around.

Theodore Reed Kendall

Legal Points for Contractors

These brief abstracts of court decisions in the contracting field may aid you in avoiding legal difficulties. Local ordinances or state laws may alter the conditions in your community. If in doubt consult your own attorney

Edited by A. L. H. Street, Attorney-at-Law

How a Contractor Unwittingly Can Become a Public Benefactor

Not infrequently a public contractor finds that he has become a sort of Santa Claus to a community, providing it with some public improvement at his own expense.

A late example appears in the case of Tobin v. Town Council of Sundance, 17 Pac. 2d, 666, decided by the Wyoming Supreme Court.

Tobin did more than $5,000 worth of street improvement work for defendant city, and was paid less than half that amount. When he sued for the balance he was confronted with a defense that the contract was awarded in violation of a statute requiring such contracts to be awarded to the lowest responsible bidder after advertisement for proposals. To "rub it in," the city demanded return of the $2,740.71 it had paid on the contract, despite the fact that the contract had been fully performed.

The court ruled that there could be no recovery by the contractor, even though the city had accepted the improvement and even though there was testimony tending to show that no one else might have bid on the job.

But the Supreme Court balked on ordering the contractor to repay what he had received under the contract, finding that the payment "was not contrary to any principle of the common law or of good morals."

Moral: No public contract should be taken without making sure that all statutory requirements governing the award of such contract have been compiled with, unless the contractor is willing to risk being regarded as having donated the work to the public.

When a Check Bounces Back Into the Payee's Hands

A subcontractor lately won a legal bout with a general contractor's bonding company. The New Jersey Supreme Court, acting as "referee" gave the subcontractor the "decision on points." It all happened this way: The subcontractor received a post-dated check from the general contractor and executed a release of lien claims. The check was dishonored for want of funds.

When the subcontractor went after the bonding company that had guaranteed that the general contractor would pay for labor and material, that company said, in effect, "My dear sir, in a legal sense you have been paid. Didn't you get a check and give a release of liens for it?"

"Yes," replied the subcontractor, "but I want to be paid in dollars and cents, as well as in a legal sense."

In giving the subcontractor the decision, the court said: "The mere acceptance of the check would not constitute payment, particularly so if it be post-dated, which happened in the instant case. A post-dated check is never more than a written promise to pay at some future date."

As to the subcontractor having given the general contractor a release of lien claims, the court said that, while that waived liens, it did not relieve the general contractor from personal liability nor the bonding company from its guaranty of discharge of that liability, especially since the subcontractor did nothing to deceive the company into supposing that his bill had been actually paid.

Who Bears Loss When Building Is Destroyed or Damaged Before Completion?

"Where will I land if fire or a storm damages this job before delivery to the owner?" That is one question that every contractor should ask himself before he takes on a construction contract. But unless a contractor has a catalog of all the unfortunate things that may happen and checks them over before signing a contract, he is likely to overlook this hazard. And if he has no indemnifying insurance, the oversight may be more than disastrous.

An object lesson appears in the decision handed down March 16, 1931, by the Pennsylvania Supreme Court in the case of Commonwealth v. Nelson-Pedley Construction Co., 154 Atl. 383. It was there decided that the construction company, or its bondsman, must stand the cost of delivering a state office building at Harrisburg in contract condition, despite destruction of a large part of the work by fire in the course of construction. Said the court:

"The contractor must complete the work in accordance with the plans and specifications, to the satisfaction and acceptance of the department, for this it has expressly agreed to do. Until it has done so, it has not complied with the contract, though the building ad interim [in the meantime] has been damaged by fire; the cost of restoration, in that event, being upon the contractor and not upon the commonwealth."

Doesn't it look as if it behooves the contractor either to make sure that he is not bearing the risk of fire or storm losses or that that risk is amply covered by insurance in his favor?

"Behold, How Great a Matter a Little Fire Kindleth!"

An Illinois road contractor's road boss caused a brush pile to be set on fire, although a stiff breeze was blowing toward a farmer's barn 200 feet away. Sequel: The United States Circuit Court of Appeals, Seventh Circuit, upheld judgment in favor of the farmer and against the contractor for $5,750, plus costs. (Cameron, Joyce & Co. v. McLouth, 70 Fed. 2d, 6.)

Compensation Act Covered Employee Injured in Contractor's Camp

By providing employees with living quarters in a road-building camp a contractor assumes the same liability for their personal safety as he does while they are at work, according to the decision rendered by the Louisiana Court of Appeal in the late case of Ivory v. Philpot Construction Co., 145 So. 784.

Ivory, a negro employee, was injured by a shot fired from a passing truck in the course of an attempt of outsiders to drive all negroes out of the locality. At the time he was asleep in a guarded camp furnished by the employing road contractor. Sustaining an award under the Louisiana Workmen's Compensation Act, the court said:

"Plaintiff lived in the quarters furnished by defendant, although pay for his tent was deducted out of his wages, and it was necessary that he live there to maintain his employment. The quarters were under the supervision and control of the defendant, and plaintiff's living in the tent on the premises of defendant was incidental to his employment, if not impliedly in the terms of his employment."

ACTION ON A $194,000 PWA BRIDGE PROJECT IN ARKANSAS

1. The rivet gang with the familiar forge and bucket working on the floor system of the steel span. 2. The girder and slab forms for the concrete bridge spans in place. 3. The reinforcing steel being placed. 4. Loading the concrete buggies from a hopper served by a bottom dump concrete bucket and crane. 5. Pouring the concrete directly into the forms and hand tamping. Photographs: Courtesy of the U. S. Bureau of Public Roads.

Building a Public Works Highway Bridge in Arkansas

DURING last winter a group of men was employed to complete a public works highway bridge across the Black River at Pocahontas, Ark. This steel span with concrete approaches is estimated to cost $194,000 when completed. The work was approved by the U. S. Bureau of Public Roads for construction by the Arkansas Highway Department on August 22, 1933, and construction began on September 26, 1933, employing 50 men. The accompanying illustrations show various activities on this project, NRH-NRM-269-D Arkansas.

A 4-Year Project at Fort Peck Dam

WORK is already under way on the Fort Peck Dam, another of the gigantic PWA projects, southeast of Glasgow, Mont., which will create a reservoir 175 miles long. The dam, which will be the largest earth-fill barrier ever undertaken, will be nearly 4 miles in length, including the wings on both sides of the main fill.

Between 600 and 700 men are already at work, clearing the reservoir site of timber, grading for the spur line, erecting buildings and setting up a temporary power line from Glasgow to the dam site. An allotment of $25,000,000 out of the total $60,000,000 has been made to cover the first year's work. The first units of heavy equipment to arrive on the scene of action were two P & H Model 700 cranes, which were unloaded at Paisley, Mont., and traveled 32 miles across country, breaking trail to the dam site.

The program of work for 1934 includes the boring of four diversion tunnels each more than a mile long, through the shale bluffs to the east of the dam; the construction of the model city of Fort Peck; the construction of dredges and other equipment, and the clearing of the reservoir basin. In 1935, the beginning of the large fill will be made with dredges working both above and below the dam site and from both sides of the stream. The work is expected to require three eight-month periods and will entail the movement of approximately 90,000,000 yards of dirt. An additional 6,000,000 tons of rock will be brought in by rail. The total length of the main dam structure will be 8,700 feet. This main fill will rise about 230 feet above the present river bed, the top being 100 feet wide, and the base more than 2,500 feet at its widest part. Inasmuch as there is no river bridge within many miles of the dam site, the 100-foot width at the top will provide a highway crossing with a stone protective paving 3 feet thick. The dam is to be of the hydraulic-fill type. Approximately 400,000 cubic yards of concrete will be used with 1,000 tons of reinforcing steel. An additional 13,000 feet of dikes or levees are to be built on the bench above the river. These dikes will rise 50 feet and have a width of 400 feet at the base, requiring the removal of approximately 5,000,000 yards of dirt.

When completed, Fort Peck Dam will create a basin 175 miles long and approximately 16 miles wide. The lake thus created will cover 332 square miles and have a shore line of 1,520 miles.

What Is So Rare?

THE report recently issued by the National Safety Council on Accident Rates in the Construction Industry for 1933 suggests this question: "What is so rare as a stitch in time?". These figures can be deduced for the year: suffering death or permanent total disability, one worker out of 725; incurring permanent partial disability, one worker out of 410; having a temporary disability of one day or more, one worker out of 8; time lost due to injuries, one day out of 20. The News Letter of the Construction Section of the National Safety Council states that in all probability not more than three contractors out of a hunderd carefully and competently analyze their accident experience in detail, taking the measures necessary to prevent the repetition of their past experiences. How about a definite and real drive to prove the news letter wrong?

How the Other Fellow Did It

Ideas That Have Already Proved Helpful to Contractors

Another Contractor Reverses Trucks at the Batchers

325. A Southern contractor required his batch trucks to drive forward under the batchers and then to back under them on alternate trips to distribute the moist spot on the truck bodies so as to prevent an accumulation of moisture on one part of the paver skip which would cause cement to stick to the skip. If more contractors left a few extra feet of roadway behind the batcher so that trucks could do this, there would be less energy wasted at the mixer, beating the skip with a sledge to loosen the cement every few batches. Furthermore, a contractor will fulfill state specifications more accurately if he sees to it that there is no opportunity for the cement to adhere to the skip for, when the skip is pounded every few batches to loosen the cement, the lucky batch gets more than its share of cement and those ahead have been lean. No contractor today would consider deliberate cheating on the amount of cement in the batch but how many times are batches alternately lean and fat because of pure carelessness? This is overcome on pavers which have automatic shaking devices and also on the older pavers where contractors have rigged up swinging booms which are used to pound the paver skip on every batch. 27.3.16

Sheet Steel Forms for Spindle and Post Bridge Rail

326. A Massachusetts contractor who specializes in bridge construction has devised a sheet steel panel form which admirably serves to produce standard bridge rail with its separate spindles and posts. The sheet steel is in variable lengths from 7 to 14 feet, the height of the bridge rail, and 3/32-inch thick. The top of the sheet is bent at right angles to the vertical section to act as a stiffener and along the bottom edge a 2 x 2-inch angle is welded to stiffen the form at that point. The top bend, in addition to stiffening the form, also acts as a guide for a specially designed steel screed which forms the flattened inverted V of the top rail. The separate spindles and posts are formed by inserting wooden boxes with circular tops to form the spaces between the spindles. Holes for bolts are drilled through the sheet steel on 12-inch centers horizontally and 16½-inch centers vertically. Bolts inserted through these holes hold ¾-inch boards over which the wooden boxes are slipped. The boxes are made with a bottom which can be easily broken to permit ready removal of the box and with the top of a hardwood semi-circular section. These boxes are used for many pourings but the bottoms are broken out whenever the forms are stripped. The forms may be stripped in 24 hours, according to specifications, but if they are allowed to remain for five or six days, the boxes can be tapped out readily without damage. The boxes are oiled before they are inserted over the boards on the sheet steel panel. If the bridge is on a grade, it is necessary to bore only the bottom hole in the boards, which are attached to the sheet steel form, slightly off center to give the proper angle to the board so that it will be vertical when the forms are set up on the bridge rail base. The top hole remains in the same place and the bottom of the board is swung as necessary. No new holes are drilled in the sheet steel, the only change being made in the location of the bottom hole in the board which acts as a guide for the boxes. Spreaders and form clamps are used at the top and center and bottom, holding the forms tightly and preventing leakage of grout into the boxes which form the openings between the spindles. 27.4.29

A Portable Compressor for Odd Jobs

327. Contractors frequently mount large portable air compressors on trucks and use them for operating one or two jack hammers regularly. One contractor whose job was visited mounted a 5 x 5½ portable gasoline-driven compressor on a truck and used it for innumerable operations. It furnished air for handy tools to break out old culverts, bridges, and head-walls and also for dressing exposed faces of concrete culverts. After culverts were built, the compressor with air tampers was used to consolidate the fill next to the concrete walls. Then there were any number of other uses to which this tool was put in the shop; it operated a spray paint gun, did riveting, drilling and other odd jobs. 27.3.19

Handling Bulk Cement with Bottom-Dump Carts

328. A particularly well-planned bulk cement handling system was observed in Indiana. The dock was roomy and there was no time lost through traffic congestion of the cement buggies. The dock was about 48 feet long so that it included the doors of two cement cars which were worked simultaneously. The runs to the two cars were about 10 feet wide and the scales for the cement were located at the center of the runway. The dumping platform was 14 feet wide by 20 feet long and contained four dumping holes, each with a steel dumping hopper and a rubber tube for delivery direct to the cement containers on the batch trucks. While the contractor was running one paver, four bottom-dump cement carts were used with four men on the docks who loaded, weighed and wheeled the carts. One man on the dock dumped the carts and set them back for the wheelers to take back to the cars. The cement dock was roofed over and covered with roofing paper, and a burlap windbreak was built completely around the dock to prevent blowing of the cement. There is always enough dust about a cement dock but any efforts that can be made to reduce the dust are well worth while. Across the track from the cement dock the contractor maintained a storage shed for sack cement where about 2,000 barrels were stored against an emergency. It happened that twice during one month this emergency storage was drawn upon because of delays in delivery of bulk cement. 27.6.30

Multiple Sprays for Curing with Asphalt Emulsion

329. On a Long Island, N. Y., job, the contractor developed a very effective machine for applying asphalt emulsion to the 10-foot concrete strip in paving a new highway. The basis of the unit was a separate tank and gasoline-operated pump with rubber air and emulsion hose but instead of applying the asphalt emulsion from a single nozzle, a frame about 10 feet wide was built carrying 13 nozzles. This frame was mounted on two 20-inch diameter disc wheels with rubber tires. A third wheel was mounted on the long pipe handle and was dropped to the pavement to give the proper angle for the application of the asphalt while spraying. Between the sprays and the disc wheels a galvanized iron shield was inserted with a rubber skirt at the bottom. Two men handled this outfit, one at the tank and pump and the other handling the spray unit. The asphalt emulsion was applied at the rate of 0.10 gallon per square yard in a single application in strips 10 feet wide for curing, and an additional application of 0.08 gallon for color. 26.6.25

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Construction Industry News

Hercules Motors Corp., Canton, Ohio, has announced the addition of three new members to its staff. Lon R. Smith has rejoined the Hercules sales organization as Assistant Sales Manager and will assist in the Hercules diesel sales program. Charles Dahlquist and G. C. Rasey will represent the company's diesel engine line in the automotive and industrial fields.

Stephens-Adamson Mfg. Co., Aurora, Ill., manufacturer of conveyors and screening machinery, has announced the election of L. S. Stephens as President to succeed D. B. Pierson. Mr. Pierson, one of the founders of the firm in 1901, was made Chairman of the Board upon the resignation of W. W. Stephens. The new president has been active in the firm since 1914. In 1921 he was made Superintendent and in 1926 Vice President in charge of production.

Bucyrus-Erie Co., South Milwaukee, Wis., has announced that Carl S. Wagner, formerly Vice President of Koehring Co., Milwaukee, has joined the staff in charge of sales promotion. P. H. Birckhead has been appointed General Sales Manager, combining domestic and foreign sales. Managers of other sales departments named are: M. J. Woodhull, large machine sales; J. A. Garber, small machine sales; L. B. Birckhead, drill and Loadmaster sales; M. F. Keese, dredge sales; R. T. Craig, foreign and export sales; and B. F. Johnston, repair sales.

Standard Equipment Co. is the new name for the company formerly known as the Powell-Davies Tractor & Equipment Co. The new company will maintain offices at the same address, 152 Horton St., Wilkes-Barre, Pa., and will handle the same lines of equipment.

Republic Steel Corp., Youngstown, Ohio, has announced the appointment of the Buhl Sons Co., Detroit, Mich., as distributor for Toncan iron. This company will maintain complete warehouse stocks of Toncan iron sheets.

Link-Belt Co., Chicago, Ill., has announced the appointment of J. J. Richards as Manager of the Vibrating Screen Department, to succeed Harry L. Strube who has been promoted to the position of Assistant Chief Engineer of the company's Philadelphia plants. Mr. Richards, who will continue to make his headquarters at Philadelphia, has been associated with the company since 1916 and since 1923 has been connected with the Vibrating Screen Department.

Michigan Alkali Co., New York City, has announced that after September 1 its general sales department will be located at 60 East 42nd Street.

Methods for Testing Subgrade Soil

A VERY extensive paper on "Subgrade Soil Testing Methods" was presented by C. A. Hogentogler and E. A. Willis of the U. S. Bureau of Public Roads at a session of the annual meeting of the American Society for Testing Materials which was held in Atlantic City in June. The authors' purpose was to describe the methods by which soil research giving profitable results can be carried on, and it illustrated the efforts required to interpret clearly test constants, the character of the information obtained by the intelligent use of them and indicated the difficulty of stating in simple terms general procedures for interpreting constants of all soils. The influence of soils on highway construction has been the subject of extensive research conducted by the Bureau of Public Roads and other bureaus, universities and state highway departments. The study of soils is divided into five phases: 1. definition of the soil properties which control the performance of road surfaces: 2. study of the physical laws governing the manifestations of these soil properties; 3. development of soil tests to determine the extent to which individual soils have these properties; 4. arrangement of subgrades in groups indicative of the presence of these physical properties; 5. determination of general conditions of road surface design and soil treatment required on the subgrades of the various groups.

Results of work along these lines have been so constructive that the study of subgrades has reached a high degree of practicability. According to a survey made in 1932 by Division 1 of the committee on materials of the American Association of State Highway Officials, twenty-six states rely in varying degrees on subgrade properties as determining factors in the design of roads and pavements, thirteen of which have laboratories equipped to perform all the routine tests suggested by the U. S. Bureau of Public Roads.

Copies of the paper "Subgrade Soil Testing Methods" may be secured by interested contractors and engineers from the American Society for Testing Materials, 260 South Broad St., Philadelphia, Pa. Price: 25 cents per single copy.

Copper Mine Waste Used as Aggregate in Northern Michigan

(Continued from page 34)

moved and the remaining strip finished by hand to the curb.

The remaining project of 7½ miles was entirely rural and consisted in shaping up with binder and finishing to a width of 20 feet with stamp-sand sheet asphalt. All work was done with a finishing machine, except extra widening on curves.

All materials were inspected and approved by the Highway Department. Texaco No. 65 asphalt paving cement was used on all the projects.

Analysis of Binder and Top Courses

The binder course consisted of crushed gravel produced locally, stamp sand and asphalt cement in the following typical proportions:

Crushed gravel	70 per cent
Stamp sand	25 per cent
Asphalt cement	5 per cent
	100 per cent

The stamp-sand sheet asphalt wearing course consisted of stamp sand, mineral filler or limestone dust, and asphalt cement in the following proportions:

Asphalt cement	9.2 per cent
Stamp sand	78.8 per cent
Mineral filler	12.0 per cent
	100 per cent

The stamp sand used was rather coarse graded, a typical analysis of which follows:

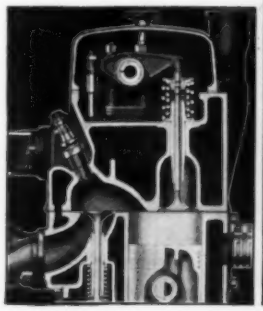
Passing	Retained	Percent
¼-inch screen	10 mesh	13.2
10 mesh	40 mesh	65.0
40 mesh	80 mesh	14.2
80 mesh	200 mesh	7.6
		100 per cent

Typical grading of crushed gravel used in the binder course follows:

Passing 1½-inch	100 per cent
" 1¼ "	82½ per cent
" ½ "	20–40 per cent
" ¼ "	0–10 per cent

This material was about 50 per cent crushed.

A WIDER RANGE OF SURPLUS CAPACITY



Here's a new heavy-duty four-cylinder power plant for excavators, cranes, tractors, locomotives, pumping, electric and heavy industrial machinery. Because this engine is deliberately rated to provide a much wider range of surplus capacity than is usually expected from engines of equal displacement . . . it is no longer necessary to compromise with a pygmy engine on a man-sized job.

It has the Waukesha Hy-Powr combustion chamber . . . the most important gasoline engine development in years . . . exclusively Waukesha. Result—power is increased 20% to 30% . . . with an equal saving in weight and size. Fuel consumption is reduced. The engine runs smoother . . . and lasts longer because of better cooling for valves and valve seats, suppressed detonation and reduced dilution.

Write for Bulletin 890.

Waukesha Motor Company, Waukesha, Wis.

NRA

WAUKESHA ENGINES

The New Door Wind-Up Attachment for Bottom-Dump Wagons Which Is Operated from the Tractor Driver's Seat

A New Door Wind-Up for Bottom-Dump Wagons

A NEW power door wind-up attachment for bottom-dump crawler wagons has recently been announced by Trackson Co., Milwaukee, Wis. These wagon winds are simple and dependable and can be inexpensively mounted on various types of bottom-dump wagons.

The mechanism which attaches to the front of the wagon is self-contained and does not interfere with the rear-end hand-winding device. It consists of a shaft carrying two narrow door-winding drums, a ratchet with a tripping arrangement, and a power-line drum, which is changeable to either end of the shaft. Across the back of the tractor is attached a beam containing a long coil spring which connects with a bell crank, and this is also changeable to either end of the beam. A cable connects this crank with the end drum of the wagon. The trip rope extends from a trip lever to the tractor driver's seat. The tractor driver simply pulls the trip rope to discharge the load. As the doors open, the cable unwinds from the large drums and winds on the end drum, so that when the doors of the wagon are open, the slack of the power-line is taken up at the end drum of the wagon.

In order to wind the doors one angle turn of the tractor is required, which unwinds the power drum and winds up the door cable carrying drums. The doors close fully at one turn of the tractor. After the doors are dumped, they remain open until the tractor driver pulls the trip rope, which enables him to leave the doors open as long as desired and to close them when he chooses. By having the dumping and door winding of bottom-dump wagons under the control of the tractor driver, the attendant hazards of men climbing on and off the equipment when in motion is eliminated.

A New Welding Electrode for Mild Steel

THE Fleetweld No. 7, a general-purpose heavily-coated electrode for welding with the shielded arc on mild steel, has recently been announced by the Lincoln Electric Co., Cleveland, Ohio. This new electrode, the use of which is claimed to have effected pronounced welding economies, is designed particularly for high speed and single pass welding. Fleetweld No. 7 has a high burn-off rate and low splatter loss. The finished bead is smooth. Tests made on specimens of all weld metal show a tensile strength of 70,000 to 80,000 pounds per square inch, a yield point of 55,000 to 60,000 pounds per square inch, ductility elongation in 2 inches approximately 20 per cent, and resistance to corrosion greater than that of mild steel.

This new electrode is manufactured in diameters of ⅛, 5/32, 3/16, 7/32, ¼, 5/16, and ⅜-inch in 14-inch lengths. The ⅛, 5/32 and 3/16-inch are designed for welding in flat, vertical or overhead position and larger sizes for welding in flat position only.

A 3-Wheel Highway Sweeper

THE Reliance 3-wheel rubber-tired sweeper for use in removing dust and dirt from roads before applying bituminous materials in many types of low-cost roads is manufactured by the Universal Road Machinery Co., Kingston, N. Y. A feature of this unit is the 3-point suspension provided by the 3-wheel mounting, giving a short turning radius and making the unit easy to steer and handle. Another feature is the new method for raising and lowering the broom, with cables operating through sheaves.

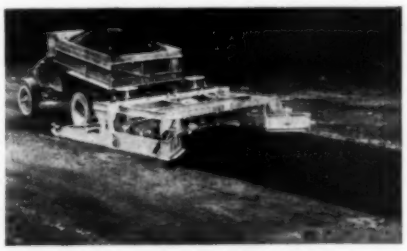
The frame is of all-steel construction, strong and durable but light in weight. The broom is mounted diagonally across the frame at the point usually occupied by the rear axle, and is engaged or disconnected as desired, through a jaw-type clutch. The control levers for the clutch and broom-raising device are within easy reach of the operator. The clutch is held firmly in position when operating the broom by a heavy coil spring.

The wheel base of this sweeper is 6 feet 3 inches, the distance center to center of the rear wheels, 8 feet 2½ inches and the height of the frame above the road, 37 inches. The wheels, equipped with Timken bearings, are provided with 27 x 3½-inch solid rubber tires or 30 x 5-inch pneumatic tires. The broom is 27 inches in diameter, 9 feet long, pitch filled with rattan or hickory.

A New Spreader-Finisher for Secondary Roads

A SCREED vibrated at 3,500 rpm for vibratory spreading, striking off and finishing; 15-foot long straight-edge sled runners which act as forms, equalize high spots and smooth the surface; and a telescoping main frame used in combination with screed extension wings to give 9 to 11-foot width adjustability are some of the features of the new Jaeger Vibro-Spreader recently announced by the Jaeger Machine Co., 701 Dublin Ave., Columbus, Ohio, for use in laying secondary roads. The machine spreads rock, gravel, macadam, hot and cold bituminous mixes, leveling and spreading both binder and top course, any width from 9 to 11 feet in any thickness between 1 and 8 inches. On two and three-lane work, the clean-up of the flushing wings insures proper blending of the strips and uniform density.

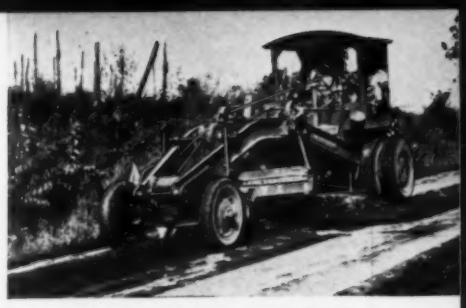
The vibration of the screed, which is also imparted to the sled runners, keeps materials plastic and reduces the drawbar pull. It is claimed that one pass with the Vibro-Screed places rock and that macadam and bituminous mixes, hot or cold, are placed ready for rolling as fast as they can be fed.

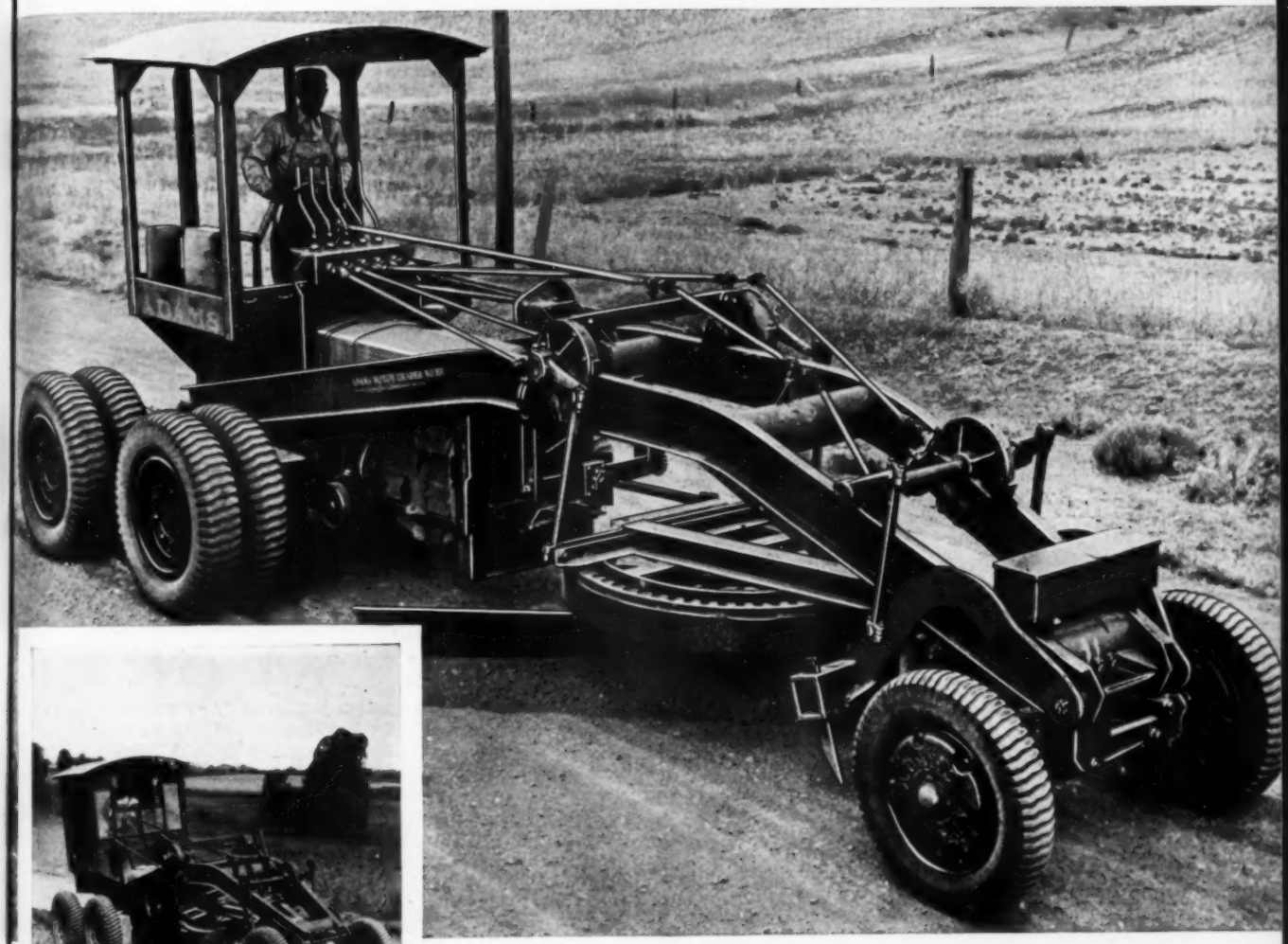


The New Jaeger Vibro-Spreader

POWER..STAMINA

AND A DRIVE TO SUIT YOUR NEEDS





WHETHER you are doing reconstruction, oil-mix, or maintenance work, Adams Motor Graders have the power, stamina and type of drive to suit your needs.

These machines are available with dual-tired, two-wheel drive, or Adams Tandem Drive (4 or 8 drive wheels) to provide the proper traction for the job. Where "soft" footing is apt to be encountered the Tandem Drive is recommended.

The Adams frame—a strong, solidly welded unit of distinctive design—provides unsurpassed strength and rigidity. Adams machine-finished construction, with adjustability for wear, assures a long, useful life.

Mail the coupon at the right for new motor grader catalog more completely describing these machines.

It may also be used to inquire about Adams Elevating Graders, Leaning Wheel Graders, Multiple-Blade Maintainers, Retread Pavers, Rotary Scrapers, Dump Trailers, etc.

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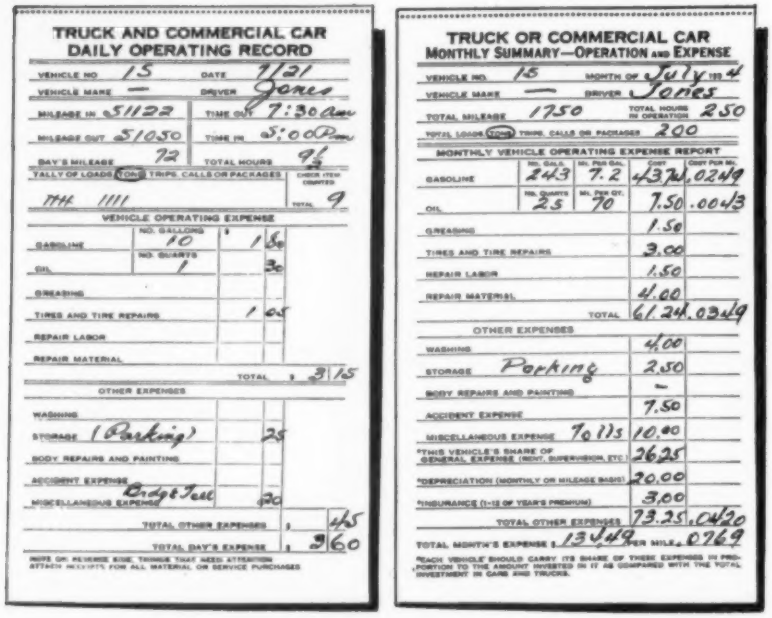


TRUCK AND COMMERCIAL CAR
DAILY OPERATING RECORD

VEHICLE NO. 15 DATE 7/21
VEHICLE MAKE — DRIVER Jones
MILEAGE IN 51122 TIME OUT 7:30 AM
MILEAGE OUT 51050 TIME IN 5:00 PM
DAY'S MILEAGE 72 TOTAL HOURS 9½
TALLY OF LOADS (TONS) TRIPS, CALLS OR PACKAGES — CHECK ITEM COUNTED
IIII IIII — TOTAL 9

VEHICLE OPERATING EXPENSE

	NO. GALLONS	$
GASOLINE	10	1 80
OIL (NO. QUARTS)	1	30
GREASING		
TIRES AND TIRE REPAIRS		1 05
REPAIR LABOR		
REPAIR MATERIAL		
TOTAL		3 15

OTHER EXPENSES

WASHING	
STORAGE (Parking)	25
BODY REPAIRS AND PAINTING	
ACCIDENT EXPENSE	
MISCELLANEOUS EXPENSE Oil & Tool	20
TOTAL OTHER EXPENSES	45
TOTAL DAY'S EXPENSE	3 60

NOTE ON REVENUE SIDE, THINGS THAT NEED ATTENTION. ATTACH RECEIPTS FOR ALL MATERIAL OR SERVICE PURCHASES

TRUCK OR COMMERCIAL CAR
MONTHLY SUMMARY—OPERATION AND EXPENSE

VEHICLE NO. 15 MONTH OF July 1934
VEHICLE MAKE — DRIVER Jones
TOTAL MILEAGE 1750 TOTAL HOURS IN OPERATION 250
TOTAL LOADS (TONS) TRIPS, CALLS OR PACKAGES 200

MONTHLY VEHICLE OPERATING EXPENSE REPORT

	No. Gals. / No. Qts.	Mi. Per Gal. / Mi. Per Qt.	Cost	Cost Per Mi.
GASOLINE	243	7.2	4374	.0249
OIL	25	70	7.50	.0043
GREASING			1.50	
TIRES AND TIRE REPAIRS			3.00	
REPAIR LABOR			1.50	
REPAIR MATERIAL			4.00	
TOTAL			61.24	.0349

OTHER EXPENSES

WASHING	4.00
STORAGE Parking	2.50
BODY REPAIRS AND PAINTING	—
ACCIDENT EXPENSE	7.50
MISCELLANEOUS EXPENSE Tolls	10.00
*THIS VEHICLE'S SHARE OF GENERAL EXPENSE (RENT, SUPERVISION, ETC.)	26.25
*DEPRECIATION (MONTHLY OR MILEAGE BASIS)	20.00
*INSURANCE (1-12 OF YEAR'S PREMIUM)	3.00
TOTAL OTHER EXPENSES	73.25 .0420
TOTAL MONTH'S EXPENSE $ 134.49 PER MILE .0769	

*EACH VEHICLE SHOULD CARRY ITS SHARE OF THESE EXPENSES IN PROPORTION TO THE AMOUNT INVESTED IN IT AS COMPARED WITH THE TOTAL INVESTMENT IN CARS AND TRUCKS.

Sample Sheets of the Chevrolet Simplified Operating Record of Truck Costs

A Simplified Cost System for Truck Owners

WHAT every truck owner ought to know,—how much his fleet operations cost, which drivers are doing the best jobs, which type and make of equipment is the most economical, which vehicles are costing so much that they should be replaced,—can be ascertained with a minimum of work by the use of a copyrighted Owners' Simplified Operating Record, which is made available to all truck owners and operators by the Chevrolet Motor Co.

This new simplified operating record is especially well-designed to fit the needs of the individual operators of small fleets of trucks. The system provides the owner with a small record book, one for each vehicle, containing a sheet for each day's record, to be filled in by the driver, and a monthly summary sheet on which the daily entries are totaled. Comparison of the summaries at the end of the month gives a definite figure on the relative operating costs of each truck in use. The monthly summary of operation and expense reveals such items as the total mileage, hours and loads for each truck; total fuel and oil and mileage per gallon or quart; fuel and oil cost per mile.

These record books are offered gratis by Chevrolet dealers and the Chevrolet Motor Co., Detroit, Mich., to any owner of trucks interested in keeping a record of his costs.

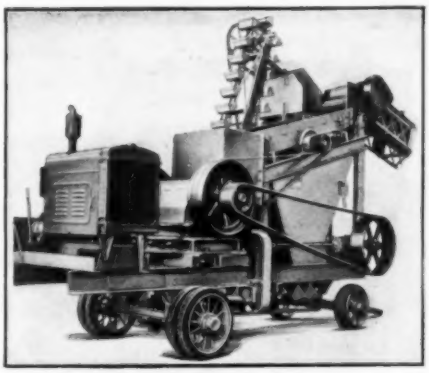
A New Service for Contractors

A NEW service for contractors and other users of P & H excavating and material handling equipment has been announced by Harnischfeger Corp., Milwaukee, Wis., in order that competent and reliable operators for these machines may be secured with the minimum trouble and loss of time. This manufacturer keeps a permanent record of all certified operators, the certificate being awarded only after five years' actual experience in operating P & H machines, in addition to passing an examination covering practical operating questions, and furnishing satisfactory references as to character and personal habits. Any contractor in need of an operator for a P & H machine may avail himself of this service by communicating with the home office of the Harnischfeger Corp., or with any of its branch offices.

A Crushing and Screening Plant on Wheels

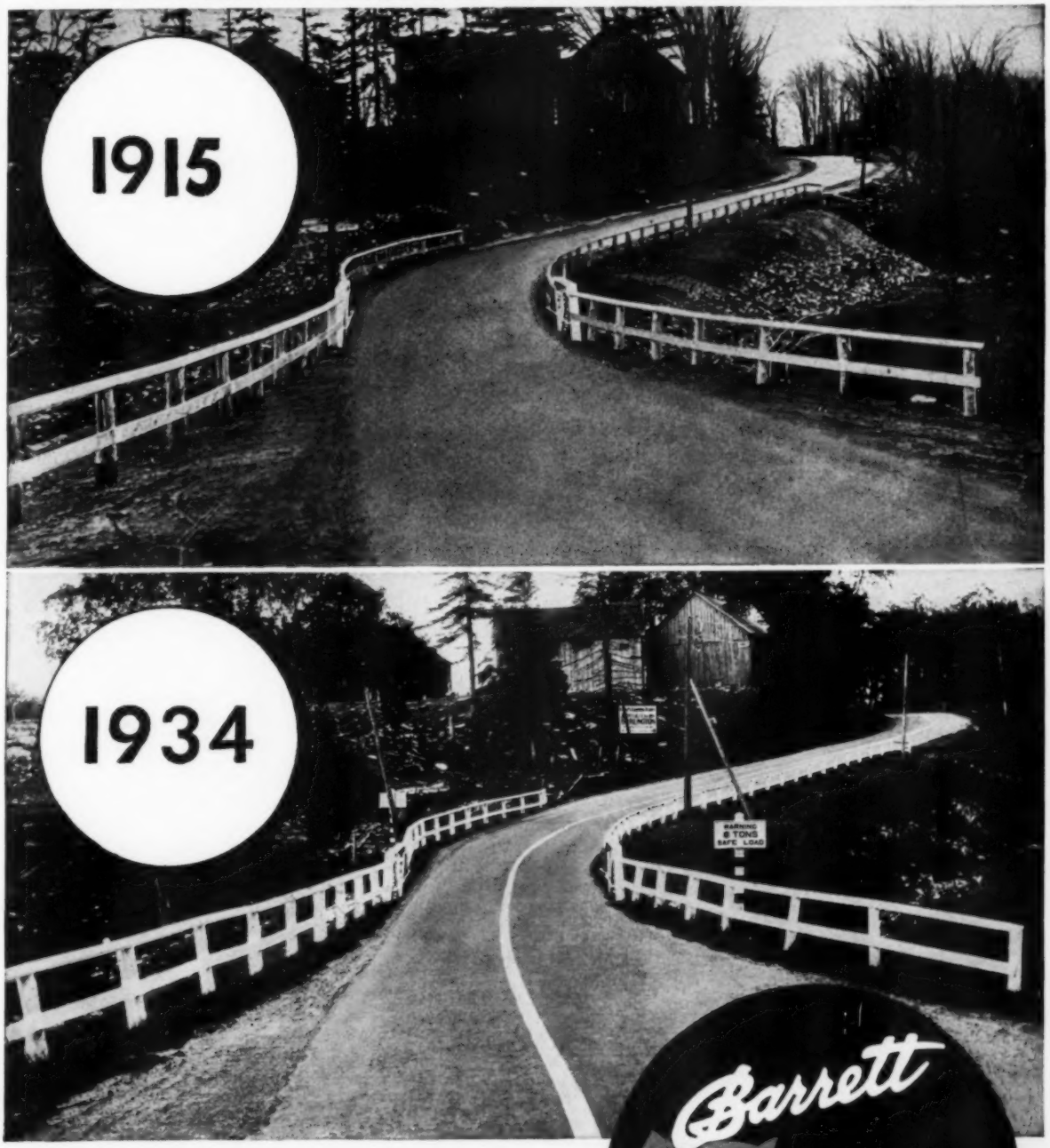
RUGGED but simple construction, complete accessibility, standard commercial equipment, and flexibility in sizing are features which combine to give the new Telsmith portable crushing and screening unit, recently announced by the Smith Engineering Works, 4014 N. Holton St., Milwaukee, Wis., the advantages of a stationary plant, plus easy portability from one job to another.

The unit consists of a crusher, jaw, gyratory or reduction, in a closed circuit with a bucket elevator and a single-deck vibrating screen. For coarse crushing, the Telsmith primary breaker delivers 1 to 2-inch rock; the Telsmith-Wheeling roller bearing jaw crusher, in three sizes, combines large feed areas with a wide sizing range and ample capacity; for secondary crushing, the No. 32-B reduction crusher turns out ¾ to 1-inch sizes and the No. 24 Gyrasphere produces ⅜ to ¾-inch rock. This two-crusher outfit offers a profitable combination of large capacities and fine sizes. The initial breaker, either jaw or gyratory, is mounted separately, at the foot of the feed conveyor. This separate mounting is designed to avoid complicated assembly, assure accessibility for repairs and eliminate transportation problems.



The New Telsmith Portable Crushing and Screening Unit

New York State Highway, Ellenburg, Franklin County Line, Tarvia-built in 1915. Faster automobiles and better traffic control today have resulted in traffic lines that were not so necessary when this Tarvia road was built.



● **In these days of high-speed automobiles, traffic-safety deserves equal consideration with economy in the selection of road materials. Tarvia gives both . . . plus a long-lasting, trouble-free road that is easy to build and maintain. The granular surface of a Tarvia road is safe against skidding at any reasonable speed. The Tarvia field man will gladly discuss your road problems with you. 'Phone, wire or write our nearest office.**

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During September we hope you will remember to mention CONTRACTORS AND ENGINEERS MONTHLY.

The New Super-Carryall Scraper

New Scraper for Self or Shovel Loading

A SUPER-CARRYALL scraper of 12-yard capacity, with a new design including all of the successful features of the former model but eliminating all center obstructions through the carrying bowl, has been announced by R. G. Le Tourneau, Inc., P. O. Box 1290, Stockton, Calif. The new design makes it possible to load the scraper by shovel or dragline, as well as by the conventional self-loading method, thus offering a double-purpose unit. The design of the bowl and apron now gives a freer disposition of material and a larger throat and higher apron opening assures free delivery of material when handling sticky gumbo or rocks.

Another feature of this new model is the use of low pressure tires of large diameter. These 20-inch air tires, which are particularly designed for construction work, will soon be standard equipment on all Le Tourneau units. The same high grade alloy steel is used throughout, with all-electric-welded construction.

The average capacity of these scrapers is 12 yards, with a cutting blade of ¾ x 10 inches x 10 feet. The bowl bottom is 9 x 10 feet and the sides are 4 feet in height. A 70 to 80-hp tractor is required to haul this unit.

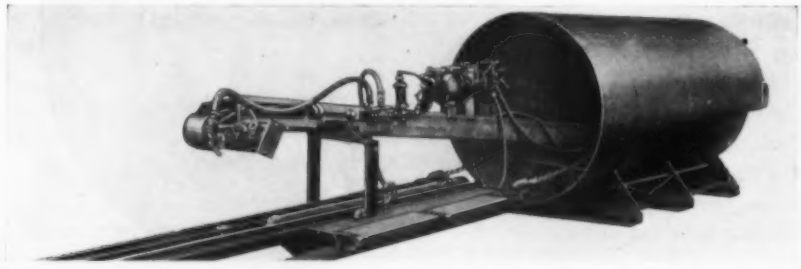
Tunnel Shields for Constructing Underground Sewers

T & M tunnel shields for constructing tunnels underground without disturbing the surface are now made by the Link-Belt Co., Tunnel & Mine Machinery Div., 112 S. 16th St., Philadelphia, Pa. This shield, which is leased to the contractor, is a combination jack-driven shield and block placer which can readily be guided to line and grade and can place 25 feet of pre-cast block lining per 8-hour shift, provided that soil conditions are such that the remaining operations can be co-ordinated to meet this pace.

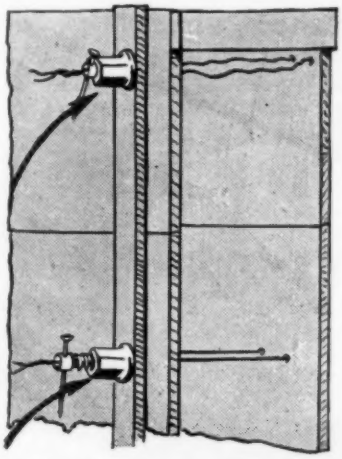
In using this shield, a shaft is first sunk on line and to a point below the grade of the required tunnel. A concrete cradle is then constructed in the bottom of this shaft to coincide with the outside diameter of the shield, and to exact line and grade of the under side of the lining. The shield is lowered onto this cradle. A pre-cast starting ring is then set in the cradle, in contact with the rear of the shield, and securely anchored in position. There are 16 to 24 hydraulic jacks located equi-distant around the rear inside perimeter of the shield. The number of jacks correspond to the number of concrete blocks required to make a complete circle of tunnel lining. The action of the jacks against each ring of the lining blocks forces the shield ahead and into the earth at the heading.

Other operations, such as spoil removal and disposal and the delivery of the blocks to the shield may be carried out in any manner which the experience of the contractor determines. The shield itself requires two men, a trained operator and a block placer.

These shields, the standard sizes of which are 4 feet to 8 feet inside diameter, although larger shields may be secured, are not designed for tunneling through hard rock. However, boulders and isolated sections of ledge rock, when encountered, have been successfully disposed of through the use of drills and dynamite. T & M tunnel shields are most effective in non-self-sustaining ground, hard clay, gravel or sand and are particularly designed for the construction of sewers, utility conduits in tunnel section and similar work.



A Side View of the T & M Tunnel Shield



The Marion Form Tightener

A New Form Tightener

A NEW form tightener, which eliminates the twisting of wire under tension and makes it unnecessary for workmen to reach or climb into the forms to twist ties for adjustments, has been announced by the Marion Malleable Iron Works, Marion, Ind.

The operation of these tighteners, which are made of certified malleable iron, is simple. The two ends of the wire tie are brought through the framework in the usual manner and passed through the tightener. A nail is inserted through the hole in the tightener screw, passing between the two ends of the tie. The wires are given a couple of turns, at the upper arrow in the illustration, and then the workman, holding the nail in one hand, uses a wrench on the nut, making the wire taut and drawing the forms together to the ultimate strength of the wire, as shown at the lower arrow. The use of this device is claimed to make the accurate alignment of forms easy and economical.